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NATIONAL DAM SAFETY PROGRAM. TORONTO RESERVOIR DAM. (INVENTORY --ETC(U)
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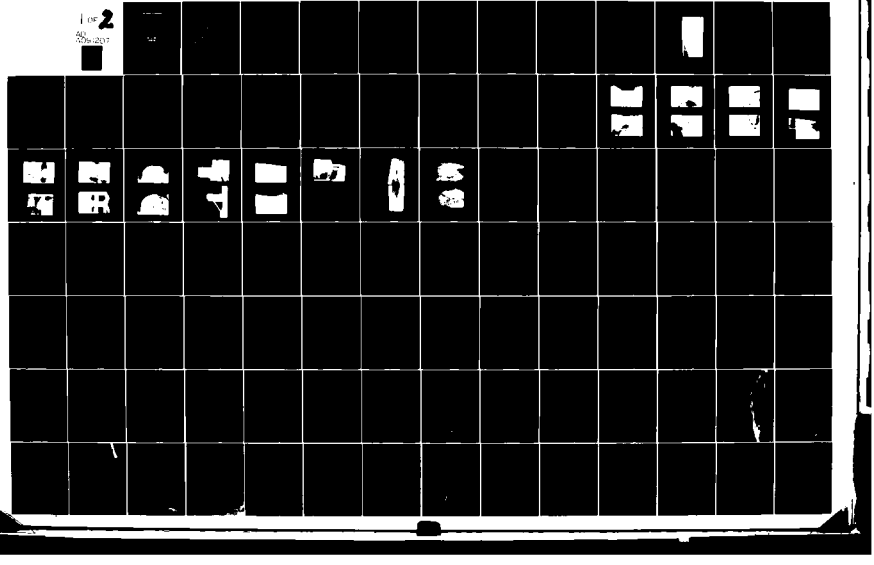

(6) National Dam Safety Program.

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TORONTO RESERVOIR DAM.

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(INVENTORY ~~NO.~~ Number NY 506), Delaware River Basin, Sullivan County, New York.

PHASE I INSPECTION REPORT,
NATIONAL DAM SAFETY PROGRAM

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NEW YORK DISTRICT CORPS OF ENGINEERS

JANUARY, 1980

392970

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A091 207
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) Phase I Insepction Report Toronto Reservoir Dam Delaware River Basin, Sullivan County, New York Inventory No. 506	5. TYPE OF REPORT & PERIOD COVERED Phase I Inspection Report National Dam Safety Program
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) George Koch	8. CONTRACT OR GRANT NUMBER(s) DACW-51-79-C-0001
9. PERFORMING ORGANIZATION NAME AND ADDRESS New York Department of Environmental Conservation 50 Wolf Road Albany, NY 12233	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS New York State Department of Environmental Conservation 50 Wolf Road Albany, NY 12233	12. REPORT DATE 15 Autust 1980
	13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Department of the Army 26 Federal Plaza New York District, CofE New York, NY 10287	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; Distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
Toronto Reservoir
Sullivan County
Black Lake Creek

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

The examination of documents and visual inspection of Toronto Reservoir Dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. The dam, however, has a number of problem areas which require investigation and remedial action.

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These areas are as follows:

1. Investigation and appropriate remedial repairs and required in connection with the observed seepage and deterioration of the concrete of the intake tower and the horseshoe outlet conduit. Since the reservoir level was approximately 40 feet below the normal pool elevation at the time of the inspection, raising the pool level could significantly increase the rate of seepage over that which was observed. Also the structural stability of the conduit must be analyzed to determine the influence of the observed seepage and deterioration. Concrete coring of the walls of the intake structure and conduit may be required to properly ascertain the structural integrity of the elements. These investigations should be conducted during reservoir filling.

2. Investigation and appropriate remedial measures are required in connection with the observed seepage encountered at the toe of the downstream slope on both sides of the outlet conduit. Construction of weirs and monitoring of flow at bi-weekly (or more frequently) intervals is necessary to properly ascertain the causes of the seepage. Monitoring of seepage should also be conducted during filling of the reservoir.

These investigations should be initiated immediately and completed within 1 year from notification to the owner.

The discharge capacity of the spillway is inadequate for all floods in excess of 82%.of the Probable Maximum Flood (PMF=25,650 cfs). The maximum reservoir level during the PMF will be 1.9 feet over the top of dam and 3.5 feet below the top of dam during the 1/2 PMF.

The following remedial actions should be completed within 1 year from notification:

3. Repair the downstream channel weir.

4. Repair the leaking gates in the intake tower.

5. Remove the trees and brush on the embankment slopes, at the abutment contacts, and on the spillway outlet channel. Provide a program of periodic cutting and mowing of the embankment surfaces and the banks of the outlet channels.

6. Repair the deteriorated concrete at the waterline of the center pier in the downstream end of the outlet conduit.

7. Provide a program of periodic inspection and maintenance of the dam at appurtenances including yearly operation and lubrication of all gates. Document this information for future reference. Also develop an emergency action plan.

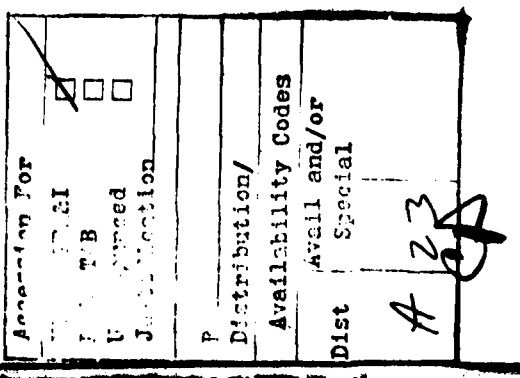
PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.



PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
TORONTO RESERVOIR DAM (I.D. No. NY 506)
DEC #148D-199 DELAWARE RIVER BASIN
SULLIVAN COUNTY

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Toronto Reservoir (I.D. No. NY 506)
State Located:	New York
County Located:	Sullivan
Stream:	Black Lake Creek (tributary of Mongoup & Delaware River)
Dates of Inspection:	November 15 & 16, 1979

ASSESSMENT

The examination of documents and visual inspection of Toronto Reservoir Dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. The dam, however, has a number of problem areas which require investigation and remedial action. These areas are as follows:

1. Investigation and appropriate remedial repairs and required in connection with the observed seepage and deterioration of the concrete of the intake tower and the horseshoe outlet conduit. Since the reservoir level was approximately 40 feet below the normal pool elevation at the time of the inspection, raising the pool level could significantly increase the rate of seepage over that which was observed. Also the structural stability of the conduit must be analyzed to determine the influence of the observed seepage and deterioration. Concrete coring of the walls of the intake structure and conduit may be required to properly ascertain the structural integrity of the elements. These investigations should be conducted during reservoir filling.

2. Investigation and appropriate remedial measures are required in connection with the observed seepage encountered at the toe of the downstream slope on both sides of the outlet conduit. Construction of weirs and monitoring of flow at bi-weekly (or more frequently) intervals is necessary to properly ascertain the causes of the seepage. Monitoring of seepage should also be conducted during filling of the reservoir.

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The discharge capacity of the spillway is inadequate for all floods in excess of 82%.of the Probable Maximum Flood (PMF=25,650 cfs). The maximum reservoir level during the PMF will be 1.9 feet over the top of dam and 3.5 feet below the top of dam during the 1/2 PMF.

The following remedial actions should be completed within 1 year from notification:

3. Repair the downstream channel weir.

4. Repair the leaking gates in the intake tower.

5. Remove the trees and brush on the embankment slopes, at the abutment contacts, and on the spillway outlet channel. Provide a program of periodic cutting and mowing of the embankment surfaces and the banks of the outlet channels.

6. Repair the deteriorated concrete at the waterline of the center pier in the downstream end of the outlet conduit.

7. Provide a program of periodic inspection and maintenance of the dam at appurtenances including yearly operation and lubrication of all gates. Document this information for future reference. Also develop an emergency action plan.

George Koch
Chief, Dam Safety Section
New York State Department
of Environmental Conservation
NY License No. 45937

Approved By:

Col. W. M. Smith, Jr.
New York District Engineer

Date: 15 AUG 1980

Photo #1
Overview of Toronto Reservoir Dam

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
TORONTO RESERVOIR DAM I.D. No. NY 506
DEC #148D-199 DELAWARE RIVER BASIN
SULLIVAN COUNTY NEW YORK

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection

Evaluation of the existing conditions of the subject dam to identify deficiencies and hazardous conditions, determine if they constitute hazards to human life and property and recommend remedial measures where necessary.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Toronto Reservoir Dam consists of a 1645 feet long earth embankment, the maximum height of which is 91 feet above the original stream bed, and a 50 feet wide spillway constructed at the right abutment in a rock cut. The upstream slope of the earth embankment is 1 vertical on 3.5 horizontal, the downstream slope is 1 on 2.5, and the crest of the dam is 25 feet wide. A low concrete cut-off section was placed at the right abutment from the edge of the spillway to approximately 350 feet to the original stream channel. The cut-off is founded on bedrock. An intake tower located in the upstream slope of the dam controls the flow to Black Lake Creek. This flow augments the storage at Cliff Lake which in turn augments Swinging Bridge Reservoir, where hydroelectric generation is conducted. Two gates (a 4' x 5' at Elevation 1178 and a 3' x 5' at Elevation 1143) control the flow into the intake tower. An 8 feet by 8 feet concrete horseshoe conduit controls the flow from the intake tower beneath the dam.

b. Location

The dam is located on Black Lake Creek, a tributary of the Mongaup and Delaware Rivers, approximately 8 miles west southwest of the city of Monticello, New York.

c. Size

The dam is 91 feet high and impounds approximately 21,850 acre-feet. The dam is classified as "intermediate" in size (40 to 100 feet in height.)

d. Hazard Classification

The dam is classified as high hazard because of its location, about 14 miles north of the Village of Mongaup and upstream of 3 other significant dams.

e. Ownership

The dam is owned and operated by Orange and Rockland Utilities Inc., 1 Blue Hill Plaza, Pearl River, New York 10965, Tel. (914) 627-2420.

f. Purpose of the Dam

The dam provides storage for the power development which is located below Swinging Bridge Dam.

g. Design and Construction History

The dam was designed in 1925 by Charles H. Tenney & Co. Engineers, 200 Devanshire Road, Boston, Mass. for the Catskill Power Corporation, Middletown, New York. The dam was constructed in 1925 by

h. Normal Operating Procedures

Water releases from Toronto Reservoir are passed over the spillway or through either of the 2 gates located in the intake tower. Flow from these gates is directed into Black Lake Creek. This break feeds Cliff Lake where a conduit, connecting to Swinging Bridge Reservoir, supplies flow to augment the storage for power development.

1.3 PERTINENT DATA

a. Drainage Area (sq. mi.)	23.20
Height of Dam (ft.)	91.
b. Discharge at Dam Site(cfs)	
Maximum Recorded Elev. 1222. (Estimated Q)	530.
Spillway @ Top of Dam	8715.
Low Level Outlet @ Spillway Crest	1375
Total Discharge at Top of Dam	10,090
c. Elevation (ft. USGS)	
Top of Dam	1230
Top of Flashboards	1220
Spillway Crest	1215
Low Level Outlet	1143
Original Streambed	1140
d. Reservoir (acres)	
Surface Area at Top of Dam	1075.
Surface Area at Top of Flashboards	930.
Surface Area at Spillway Crest	860.
e. Storage (acre-feet)	
Top of Dam	33,250
Top of Flashboards	25,300
Spillway Crest	21,850

f. Dam

Type: Homogenous earth with concrete cutoff and internal reinforced concrete drain.

Length(ft.)	1645.
Upstream Slope	3.5 H:1 V.
Downstream Slope	2.5 H:1 V.
Crest Width (ft.)	25.

g. Spillway

Type: Channel cut to bedrock with concrete walls and five foot high flashboards.

Channel Width (ft.)	50.

h. Reservoir Drain

Type: Reinforced concrete tower inlet to eight foot horseshoe tunnel.

Control: Manually operated shoe gates, one 4' x 5' at elevation 1178 ft. and another 3' x 5' at elevation 1143 ft.

SECTION 2: ENGINEERING DATA

2.1 GEOLOGY

Toronto Reservoir Dam is located in the "Appalachian Uplands" physiographic province of New York State. This province (northern extreme of the Appalachian Plateau) was formed by dissection of the uplifted, but flat lying sandstones and shales of the middle and upper Devonian Catskill Delta. Relief is high to moderate. Maximum dissection occurs in the Catskill Mountain area, where only the mountain peaks approximate the original plateau surface. Drainage in the vicinity is southeastward and then south toward the Delaware River System.

2.2 SUBSURFACE INVESTIGATION

No subsurface investigation could be located for the project. However, the "General Soil Map of New York State" prepared by Cornell University Agriculture Experiment Station indicates that the surficial soils are of the Lackawanna series. This soil series, of glacial till origin, has poor internal drainage characteristics. Boulders are common and depth to bedrock is variable. Sandstone bedrock was observed outcropping in the excavated spillway channel and in the bed of the original stream channel below the dam.

2.3 DAM AND APPURTENANT STRUCTURES

The dam was designed by Charles H. Tenny, 200 Devonshire Rd., Boston, Mass. Available drawings have been included in Appendix E. Drawings KK3-360 & 371 were proposed modifications which were not built, but are included for illustrative purposes. The design of the dam includes a core material extending from the crest centerline to the base and core trench area with the approximate limit of the core having a slope of 1.on 1 from the crest. A concrete cut-off section, founded on bedrock, extends from the spillway to the original stream channel. The upstream and downstream toes are rock fill. The spillway is located in a rock cut at the right abutment.

2.4 CONSTRUCTION RECORDS

Some construction information is on file with the owner, the exact content is unknown.

2.5 OPERATION RECORD

All information concerning operation and maintenance of the dam is in file with the maintenance staff. The extent of data is believed to be limited to monthly elevation recordings.

2.6 EVALUATION OF DATA

Some of the data presented in this report has been made available by representatives of Orange and Rockland Utilities Inc. This information has been invaluable in preparation of this report and appears adequate and reliable for Phase I Inspection purposes.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of Toronto Reservoir Dam and the surrounding watershed was conducted on November 15 and 16, 1979. The weather was partly cloudy and the temperature ranged in the twenties. The reservoir level at the time of the inspections was approximately Elevation 1180, or 40 feet below normal pool elevation due to repair work on the intake tower.

b. Embankment

The earth embankment shows no signs of major distress with the exception of the seepage noted below. The crest and the slopes are in good condition with no evidence of sloughing subsidence, cracking or erosion. The slopes are riprapped with sandstone and shale boulders. Trees and low brush were evident on the slopes and at the abutments. The maintenance staff was removing the large trees on the left side of the dam during the inspections. (See Photos #1, 16 & 18)

c. Seepage

Seepage was observed emanating from the downstream toe of the dam on both sides of the horseshoe conduit outlet. The seepage was evident at three concentrated locations on the right side of the conduit. (See Photos #4, 5, 6 & 7). The flow, estimated to be 10 gallons per minute(gpm).from each of the 3 locations was clear and no particle migration was observed. However, the areas immediately below the seepage points were rusty colored (algae and stained soil particles) and appeared to be distributed in a delta form shape in the backwater of the downstream channel.

Seepage was observed at the right abutment contact from an area approximately 10 feet wide. (See Photo #6 left of person in photo). This flow is estimated to be 10 gpm and did not appear to be as rusty as the concentrated areas. No migration of particles was noted.

On the left side of the conduit outlet a flow of about 2 gpm was observed emanating from a 4 inch diameter plastic pipe. (see Photo #8) The point of seepage is approximately 15 feet from the downstream end of the conduit and 5 feet above the water level of the downstream channel.

In the downstream channel immediately below the toe of the dam seepage was noted emanating from both sides of the channel for a distance of 75 feet. The seepage was clear, no evidence of particle migration observed, and the rate of flow estimated to be a total of 10 gpm. (5 gpm each side).

A 4 inch diameter plastic pipe was noted at the left abutment contact about 100 feet left of the conduit. No flow was observed from the pipe or in the area of the abutment.

At the right abutment contact, approximately 200 feet right of the conduit, a 1/2 inch diameter pipe was observed. A valve at the end of the pipe was restricting any inspection of the interior of the pipe.

The purpose of the pipe is unknown.

The total flow of seepage observed at and along the toe of the dam is estimated to be in excess of 50 gpm. Maintenance personnel reported observing the seepage as described above for at least several years. A weir was noted across the downstream channel about 300 feet below the dam. (see Photo #3). No flow was observed over the weir due to the permeable nature of the soil surrounding it. This weir was reported to be used for flow measurements in the past. These records were not available at the time of the inspection. An additional weir was monitored in the outlet conduit and these readings were subtracted from the downstream weir to achieve a flow rate for the seepage. Seepage in the outlet conduit will be discussed in a following section. It should be noted that the estimated flow rate of 50 gpm, with the reservoir level 40 feet below normal pool, may be substantially increased when the reservoir is returned to normal operating levels.

d. Spillway

The spillway, located at the right abutment of the dam is excavated into and founded on bedrock. Five feet high flashboards were in place at the time of the inspection. The spillway is considered to be in good condition. (See Photo #20). The outlet channel of the spillway is ripraped and heavily vegetated. (see Photo #19)

e. Regulating Outlets

The concrete of the intake tower is deteriorated in some places to the point where reinforcing is exposed. In addition, ice loading has cracked the concrete walls about 44 feet below the upper floor of the intake tower. At the time of the inspection repairs were in progress to clean, patch, and bolt across the cracks with 10 inch wide 6 feet long channels. (See photos #16 & 17).

A 4' x 5' high level gate at Elevation 1178 and a 3' x 5' low level gate at Elevation 1143 serve to control the flow to the intake tower. The high level gate was leaking at a rate of about 10 gpm and the low level gate was leaking at a rate of 5 to 10 gpm. (See photo #15)

The 8 feet by 8 feet horseshoe outlet conduit is deteriorated and seepage was evident at all joints. Approximately 2 gpm was noted seeping from the roof of the fourth joint from the downstream end of the conduit (75 feet). (See Photo #14). An additional 1 to 2 gpm was observed emanating from the roof of the first joint from the upstream end of the conduit. (See Photo #15) Calcification was also present at all joints. The concrete at the first joint from the downstream end is severely deteriorated. The maximum depth of deterioration was measured to be 12 inches on the left side of the conduit and 8 inches on the right side. Reinforcing was exposed on both sides. (See photos 11 & 12).

The concrete of the outlet conduit at the downstream end is also deteriorated. (See Photos #9, 10 & 13). The center pier in the outlet works is severly deteriorated at the water line (See Photo #13) and reinforcing is exposed.

The remainder of the conduit appears to be in good condition with no

evidence of movement, or misalignment. The gates are reported to be operational.

f. Downstream Channel

The downstream channel appears to be in good condition. (See Photos #2 & 3). The channel bed is riprapped. Flow in the channel is used to augment the power generating capability at Swinging Bridge Reservoir.

g. Reservoir

There are no visible signs of instability or sedimentation problems in the reservoir area.

3.2 EVALUATION OF OBSERVATIONS

Significant conditions were observed which require immediate investigation to determine the type of extent of corrective action necessary to insure the stability of the dam and appurtenances. The following is a summary of the problem areas encountered, in order of importance, with the appropriate recommended action:

1. The seepage and deterioration of the intake structure and outlet conduit must be investigated immediately. The seepage investigation should be conducted during filling of the reservoir. Coring of the concrete may be required to investigate the structural integrity of the conduit.

2. The seepage observed at the toe of the downstream slope on both sides of the outlet conduit must be investigated immediately. This investigation should also be conducted during reservoir filling. Construction of weirs and monitoring at bi-weekly intervals during filling is required. The level of the reservoir must be used to correlate this information.

3. Repair the downstream channel weir which is leaking.

4. Repair the leaking gates in the intake tower. Provide a program of periodic inspection and maintenance of the dam and appurtenances including yearly operation and lubrication of the gate system.

5. Remove the trees and brush on the embankment slopes, at the abutment contacts and in the outlet channel of the spillway. Provide a program of periodic cutting and mowing of the embankment surfaces and outlet channels.

6. Repair the deteriorated center pier of the outlet works.

7. Develop an emergency action plan.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURE

4.1 Procedures

The normal water surface is approximated by the top of the flashboards (5 feet in height), Elevation 1220. The reservoir surface may be lower due to the demand for water to generate power at Swinging Bridge Reservoir. This demand is supplied by either of 2 gates in the intake tower, a 4' x 5' high level gate at Elevation 1178, and a 3' x 5' low level gate at Elevation 1143, the flow from which is transmitted beneath the dam by an 8' x 8' horseshoe conduit.

4.2 Maintenance of the Dam

The dam is maintained by the owner, Orange and Rockland Utilities, Inc. Maintenance of the dam is not considered satisfactory as evidenced by the deteriorated concrete elements of the intake tower and conduit system, the uncontrolled seepage at the toe, the leaking gates, and the extensive growth of trees and brush on the slopes of the dam and the abutments.

4.3 Warning System

An excellent warning system has been developed by the owner, in accordance with the Federal Energy Regulating Commission standards. This system was updated (Dec. 7, 1978) and is included in Appendix E.

4.4 Evaluation

The dam and appurtenances have not been maintained in satisfactory condition as noted in "Section 3: Visual Inspection."

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Drainage Area Characteristics

The Toronto Reservoir Dam is located on the Black Lake Creek, a tributary of the Mongaup River. The Drainage Area at the dam site is 23.20 square miles. The topography is characterized by moderate to steep slopes interspersed by lakes and swamps. The lakes and swamps combine to create a large amount of upstream storage.

5.2 Analysis Criteria

The analysis of the spillway capacity of the dam and storage of the reservoir was performed using the Corps of Engineers HEC-1 computer model. The unit hydrograph was defined by the Snyder Synthetic Unit Hydrograph method, and the Modified Puls routing procedure was incorporated. The Probable Maximum Precipitation (PMP) was 21.0 inches (24 hrs., 200 sq. miles) from Hydrometeorological Report #33. The floods selected for analysis were the PMF and the 1/2 PMF in accordance with recommended guidelines of the Corps of Engineers. The PMF inflow of 25650 cfs was routed through the reservoir and the peak outflow was determined to be 21,563 cfs.

5.3 Spillway Capacity

The spillway is a 50' long channel cut to bedrock with 5' flashboards. The height from the spillway crest to top of dam is 15'; it is assumed that flashboards will fail at 3' over the top of flashboards. The capacity at the top of dam is 8715 cfs.

5.4 Reservoir Capacity

The reservoir capacities at the crest of the spillway, and at the top of the flashboards are 21,850 acre-feet and 25300 acre-feet respectively. Total storage capacity to top of dam is 33,250 acre feet. Surcharge storage, spillway crest to top of dam, is 11,400 acre feet or equivalent to a runoff depth of 9.2 inches over the drainage area.

5.5 Floods of Record

Maximum elevation recorded was on July 20, 1945, elevation 1222.0 or 2' over the flashboards. The estimated discharge at this time was 540 cfs.

5.6 Overtopping Potential

The maximum capacity of the spillway assuming the flashboards fail is 8715 cfs. Hence, it will adequately pass the 1/2 PMF event but the dam will be overtopped by approximately 1.9' during the PMF inflow of 25,650 cfs. The routed outflow for the 1/2 PMF and PMF are 6850 cfs and 21,563 cfs respectively.

5.7 Evaluation

The spillway is inadequate to pass the routed PMF outflow of 21,563 cfs without overtopping,however, the spillway will pas the 1/2 PMF outflow of 6850 cfs with approximately 2 feet of freeboard. The spillway is inadequate for all storms in excess of 75% of the PMF.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

No signs of major distress were observed in connection with the earth embankment or the spillway section. However, seepage was observed at the toe of the dam and within the outlet conduit estimated to be in excess of 50 gpm with the reservoir at a level 40 feet below normal pool. In addition the intake tower and the outlet conduit is severly deteriorated (reinforcing is exposed) and the intake tower experienced cracking due to ice loading.

b. Design and Construction Data

No design or construction data could be located concerning the structural stability of the dam.

c. Operating Records

No operational problems were reported which would affect the structural stability of the dam.

d. Post-Construction Changes

During the time of the inspections channels were being bolted across the cracked areas of the intake tower to insure the stability of the tower. Also, monitoring of the seepage at the toe of the dam has been recorded in the past. Unfortunately, these records could not be located.

e. Seismic Stability

The dam is located in seismic Zone 1. Seismic forces in this zone are not considered to be of significant magnitude to influence the stability of the structure. A detailed stability analysis of the earth embankment is beyond the scope of this report. The "Preliminary Brittle Structures Map of New York", by Isachsen and McKendree, indicates that no faulting or slides are present within the watershed area or near the dam.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 Assessment

a. Safety

The Phase I Inspection of Toronto Reservoir Dam did not reveal conditions which constitute an immediate hazard to human life or property. The embankment and horseshoe outlet conduit have a number of problem areas which require immediate attention.

b. Adequacy of Information

Information reviewed for the purposes of the Phase I Inspection report is considered adequate.

c. Urgency

The investigation listed below require immediate attention. All investigations and remedial actions described below should be completed within 1 year of notification to the owner.

d. Need for Additional Investigation

Additional investigations are required in the following areas:

1. Seepage and deterioration of the intake tower and the outlet conduit must be investigated. Coring of the conduit walls and intake tower may be required to determine the structural integrity of the conduit. Investigation of the seepage at the joints of the conduit should be conducted during reservoir filling operations to correlate seepage rate with reservoir level.

2. Seepage at the toe of the dam on both sides of the outlet conduit must be investigated. Construction of weirs and monitoring of flow at bi-weekly intervals(more frequent readings may be required depending upon reservoir level increases) during reservoir filling, is required to properly ascertain if the rate of seepage is dependent upon the reservoir level, and any consequences thereof.

7.2 Recommended Measures

1. Results of the aforementioned investigations will determine the type and extent of remedial measures required.

2. Repair the downstream channel weir.

3. Repair the leaking gates in the intake tower.

4. Remove the trees and brush on the embankment slopes, at the abutment contacts and on the spillway outlet channel banks. Provide a program of periodic cutting and mowing of the embankment surfaces and the banks of the outlet channels.

5. Repair the deteriorated concrete at the water line of the center pier in the downstream end of the outlet conduit.

6. Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of all gates. Document this information for future reference.

APPENDIX A

PHOTOGRAPHS

Photo #2
Downstream Face of Dam

Photo #3
Weir in Downstream Channel
Immediately below Photo #2

Photo #4
Toe of Downstream Slope
Note Rusty Areas

Photo #5
Close-Up of Seepage
(Location: Slightly to the right of person in Photo #4)

Photo #6
Seepage at Toe of Right Abutment Contact

Photo #7
Close-Up of Seepage
(Location: at extreme right of Photo #6)

Photo #8
Seepage on Left Side of Horseshoe Conduit

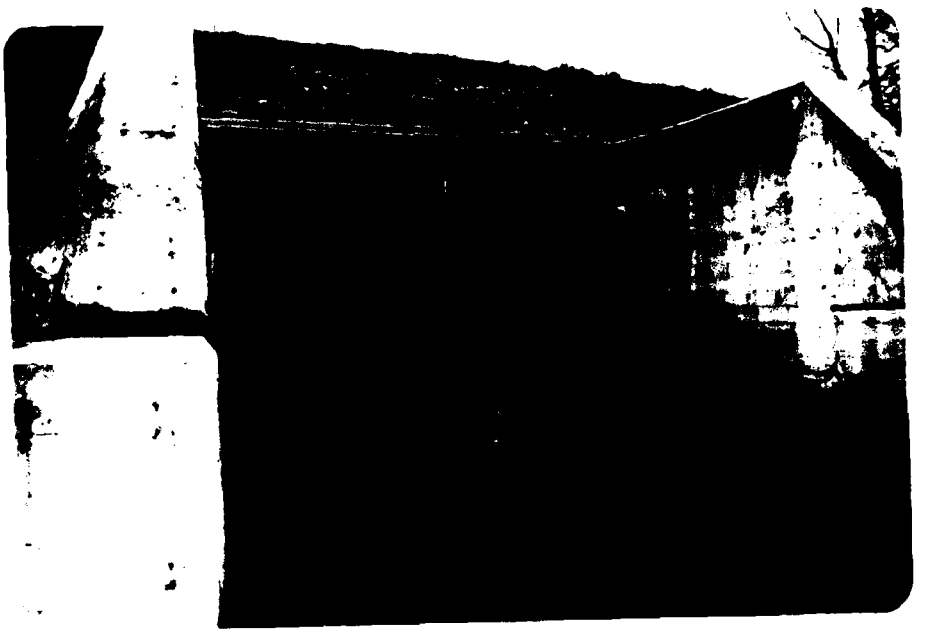


Photo #9
Outlet of Conduit
(Note deterioration & calcification)

Photo #10
Upstream Face of Energy Dissipator at Outlet of Conduit

Rhoto #11
Deterioration of Left Wall of Conduit
(Firts joint from outlet end)

Photo #12
Deterioration of Right Wall of Conduit
(Opposite Photo #11)

Photo #13
Outlet of Conduit Looking Downstream
(Note deterioration of center wall)

Photo #14
Seepage from Conduit Joint
(Approx. 75 feet from downstream end)

Photo #15
Seepage from Conduit Joint
(First Joint from Upstream End)

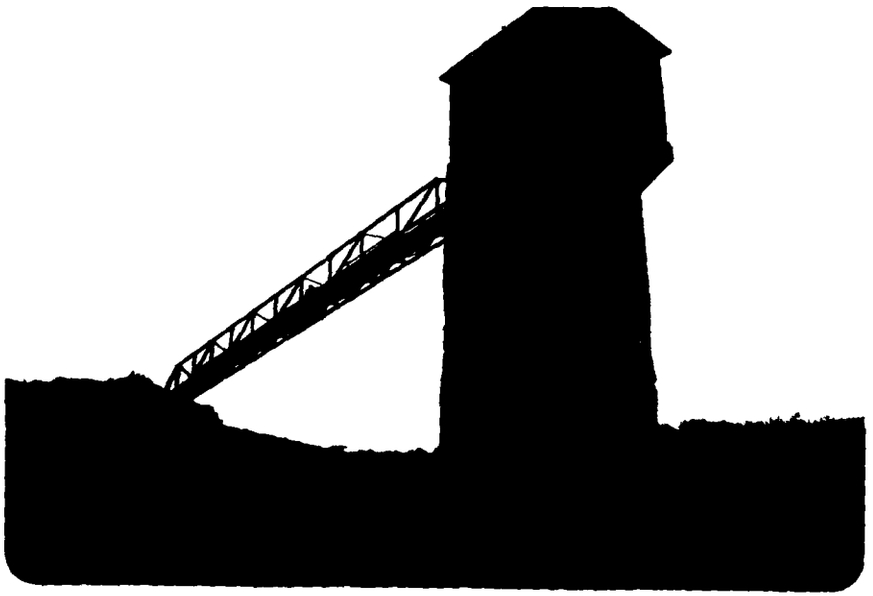


Photo #16
Intake Tower

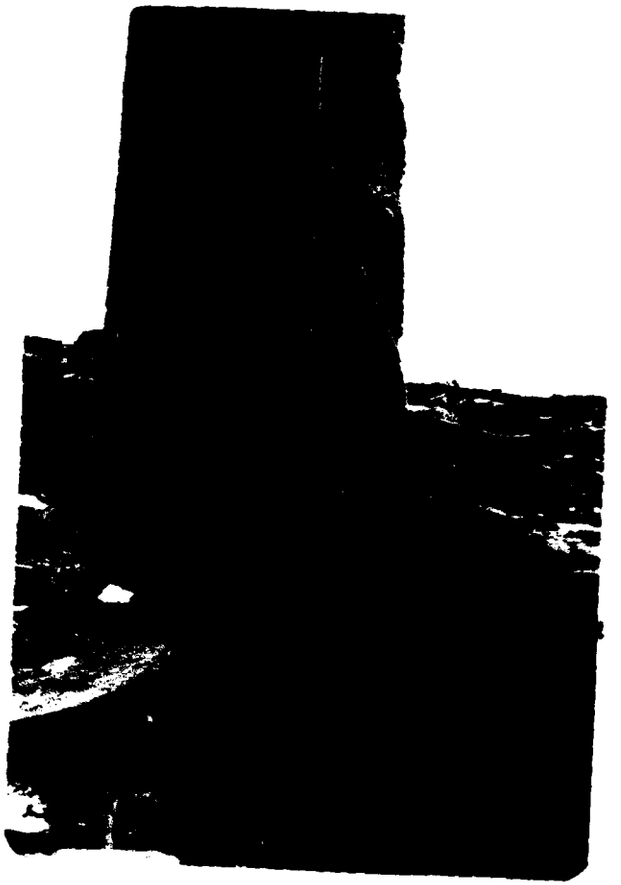


Photo #17
Upstream face of Intake Tower
(Note bolted channels)

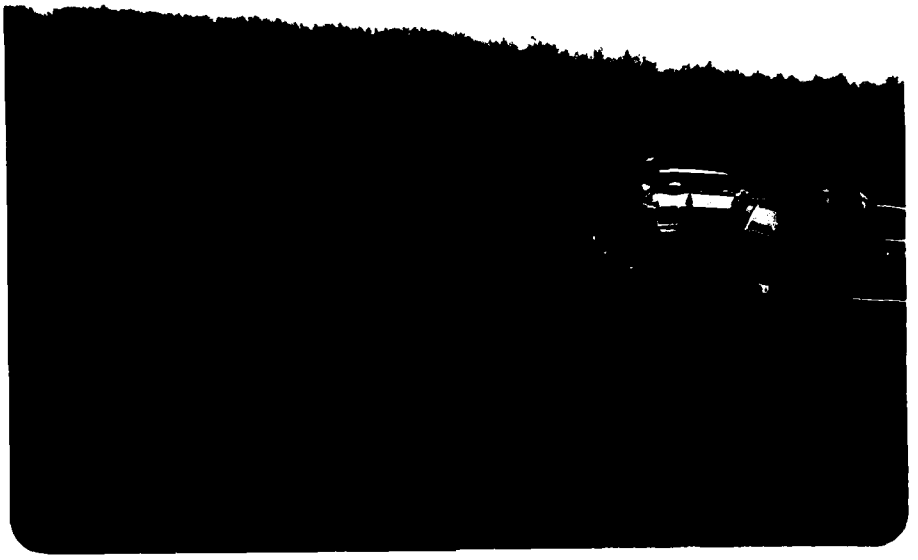


Photo #18
Crest of Dam & Right Abutment
(Spillway in background)

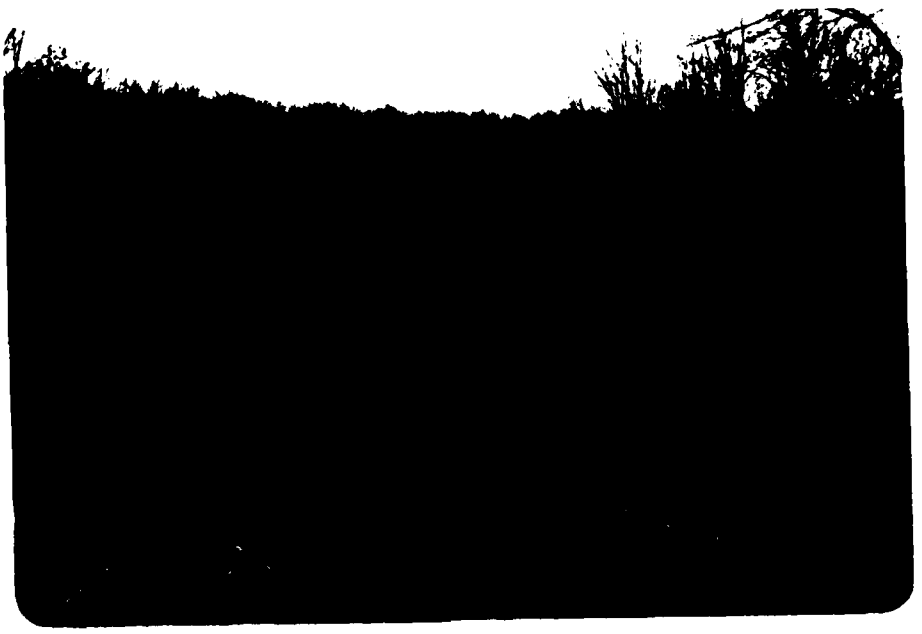
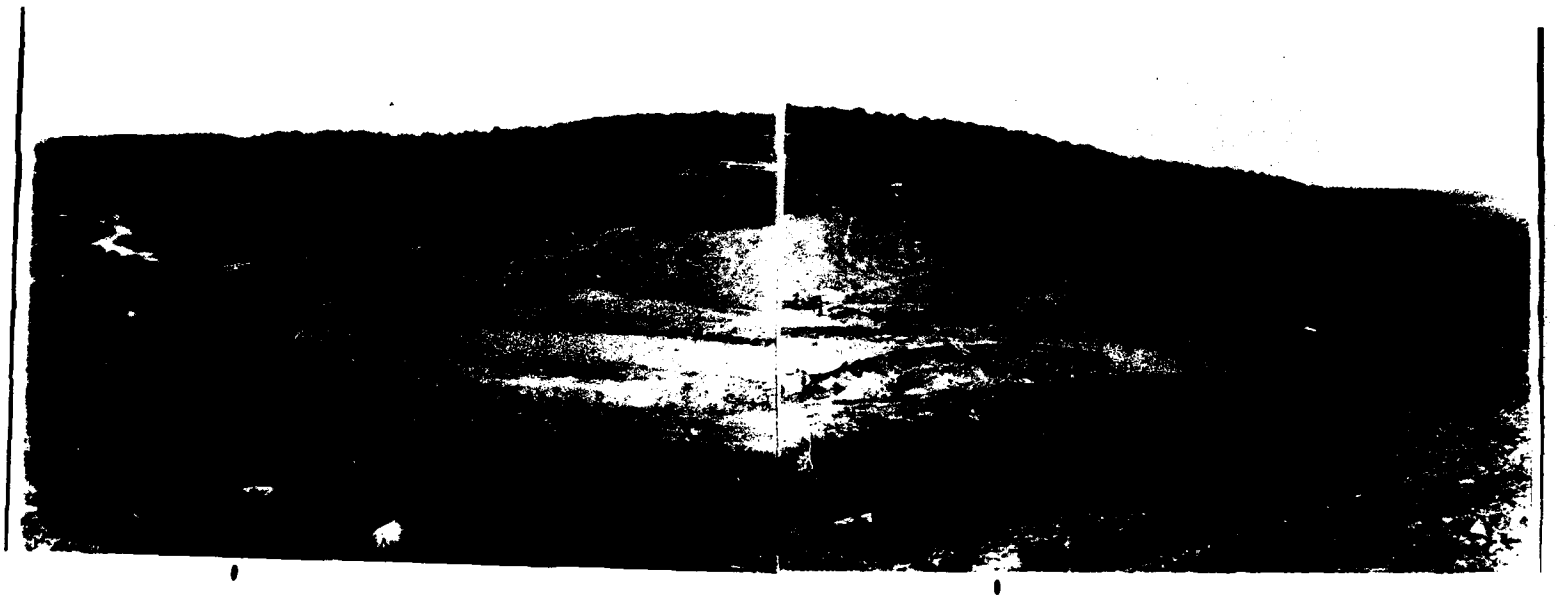


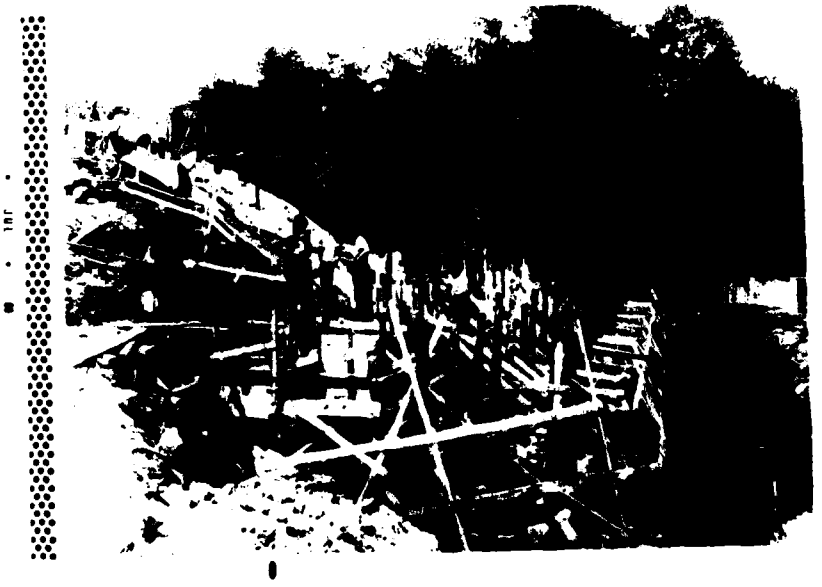
Photo #19
Outlet channel of spillway

Photo #20
Spillway
(looking upstream)



Construction Photos July 1, 1925 Viewed from Right Abutment

Construction Photos July 1, 1925



Above: Downstream End of Outlet Conduit
Below: Construction of Cut-Off (Right Side of Conduit.)

APPENDIX B

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Tooantoo Reservoir

Fed. I.D. # NY 506 DEC Dam No. 149 D-199

River Basin Delaware

Location: Town Bethel County Sullivan

Stream Name Black Lake Creek

Tributary of Mongaup & Delaware Rivers

Latitude (N) 41° 37' 15" Longitude (W) 74° 49' 55"

Type of Dam Earth with concrete

Hazard Category C Unk

Date(s) of Inspection 11/13 & 16/79

Weather Conditions Partly Cloudy, mid 30's

Reservoir Level at Time of Inspection Elev 1152.2

b. Inspection Personnel J. C. Verbek R. P. McCarthy

c. Persons Contacted (Including Address & Phone No.)

Chuck Kane (Owner) 914-434-6041

School Street Bethel, N.Y. 12720

NY Water 914-457-3180

d. History:

Date Constructed 1950's Date(s) Reconstructed [illegible]

Designer [illegible]

Constructed By Unk

Owner [illegible]

2) Embankment

a. Characteristics

(1) Embankment Material

(2) Cutoff Type

(3) Impervious Core

(4) Internal Drainage System

(5) Miscellaneous

b. Crest

(1) Vertical Alignment

(2) Horizontal Alignment

(3) Surface Cracks

(4) Miscellaneous

c. Upstream Slope

(1) Slope (Estimate) (V:H) 1:3 ±

(2) Undesirable Growth or Debris, Animal Burrows

(3) Sloughing, Subsidence or Depressions

(4) Slope Protection _____

(5) Surface Cracks or Movement at Toe _____

d. Downstream Slope

(1) Slope (Estimate - V:H) 1 : 2.5

(2) Undesirable Growth or Debris, Animal Burrows Some trees & bush

(3) Sloughing, Subsidence or Depressions _____

(4) Surface Cracks or Movement at Toe _____

(5) Seepage _____

(6) External Drainage System (~~Ditches, Trenches;~~ Blanket) _____

(7) Condition Around Outlet Structure _____

(8) Seepage Beyond Toe _____

e. Abutments - Embankment Contact

_____

(1) Erosion at Contact

(2) Seepage Along Contact

3) Drainage System

a. Description of System None

b. Condition of System

c. Discharge from Drainage System

4) Instrumentation (Momumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.)

None

5) Reservoir

a. Slopes

b. Sedimentation

c. Unusual Conditions Which Affect Dam

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.)

b. Seepage, Unusual Growth

c. Evidence of Movement Beyond Toe of Dam

d. Condition of Downstream Channel

7) Spillway(s) (Including Discharge Conveyance Channel)

a. General

b. Condition of Service Spillway

c. Condition of Auxiliary Spillway _____

d. Condition of Discharge Conveyance Channel _____

8) Reservoir Drain/Outlet

Type: Pipe _____ Conduit Horseshoe shape Other _____

Material: Concrete ✓ Metal _____ Other _____

Size: 8' x 8' Length 500 ±

Invert Elevations: Entrance 1143 Exit 1141

Physical Condition (Describe): Unobservable _____

Material: _____

Joints: _____ Alignment _____

Structural Integrity: _____

Pipe in outlet works _____

Hydraulic Capability: _____

Means of Control: Gate ✓ Valve _____ Uncontrolled _____

Operation: Operable ✓ Inoperable _____ Other _____

Present Condition (Describe): _____

9) Structural

a. Concrete Surfaces

b. Structural Cracking

c. Movement - Horizontal & Vertical Alignment (Settlement)

d. Junctions with Abutments or Embankments

e. Drains - Foundation, Joint, Face

f. Water Passages, Conduits, Sluices

g. Seepage or Leakage

h. Joints - Construction, etc. _____

i. Foundation _____

j. Abutments N/A

k. Control Gates _____

l. Approach & Outlet Channels _____

m. Energy Dissipators (Plunge Pool, etc.) _____

n. Intake Structures _____

o. Stability _____

p. Miscellaneous _____

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

a. Description and Condition

APPENDIX C

HYDROLOGIC / HYDRAULIC

ENGINEERING DATA AND COMPUTATIONS

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam	1230.0	1375.	33250.0
2) Design High Water (Max. Design Pool)	—	—	—
3) Auxiliary Spillway Crest	—	—	—
4) Pool Level with Flashboards	1220.0	930.	25300.0
5) Service Spillway Crest	1215.0	860.	21850.0

DISCHARGES

	Volume (cfs)
1) Average Daily	UNKNOWN.
2) Spillway @ Maximum High Water (Top of Dam)	5715 cfs (Was-but exceeded)
3) Spillway @ Design High Water	—
4) Spillway @ Auxiliary Spillway Crest Elevation	—
5) Low Level Outlet	1375.
6) Total (of all facilities) @ Maximum High Water	11090.
7) Maximum Known Flood	530.
8) At Time of Inspection	—

CREST: ELEVATION: 1215.

Type: EXCAVATED CHANNEL TO BEDROCK, 5' FLASHBOARDS

Width: 50' Length: 500'

Spillover —

Location LEFT ABUTMENT

SPILLWAY:

SERVICE		AUXILIARY
1215.	Elevation	—
CHANNEL	Type	—
50'	Width	—
	Type of Control	
—	Uncontrolled	—
	Controlled:	
5' FLASHBOARDS	Type (Flashboards; gate)	—
—	Number	—
—	Size/Length	—
	Invert Material	—
	Anticipated Length of operating service	—
500'	Chute Length	—
—	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	—

HYDROMETEROLOGICAL GAGES:

Type : NONE BLACK CREEK

Location: _____

Records: RESERVOIR USGS WATER RESOURCES.

Date - July 20, 1995

Max. Reading - 1222.0

FLOOD WATER CONTROL SYSTEM:

Warning System: UPDATED DEC. '95 IN ACCORDANCE WITH FERC.

Method of Controlled Releases (mechanisms):

MANUAL

DRAINAGE AREA: 23.26 SQ. MI.

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: [illegible]

Terrain - Relief: [illegible]

Surface - Soil: [illegible]

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

Low / Dearmare River Basin Study

Potential Sedimentation problem areas (natural or man-made; present or future)

—

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

—

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: —

Elevation: —

Reservoir:

Length @ Maximum Pool [illegible] (Miles)

Length of Shoreline (@ Spillway Crest) [illegible] (Miles)

Tributary Res cont.

HEC-1 Snyder Parameters

L = 7.1 Mi Due to topography, cover and low runoff

L_{ca} = 2.5 Mi. potential ASSUME $C_t = 2.3$

$t_p = C_t (L \cdot L_{ca})^{0.3}$ ASSUME AVE. $C_p = 0.625$

$= 2.3(7.1 \cdot 2.5)^{0.3} = 5.15$ hr.

$t_r = t_p / 5.5 = 1.00$ $T_p = t_p + .5(t_r) = 5.9$ hrs.

Height of Overtopping (10650 cfs - 8715 cfs) = 1935 cfs

$Q = CLH^{3/2}$

$1935 \text{ cfs} = h^{3/2}(1600')30$

$h = .55'$

Low Level outlet $Q = CA\sqrt{2gh}$

$Q_1 = .6(15)\sqrt{2(32.2)(1230 - 1143 + 2.5)} = 675$ cfs

$Q_2 = .6(20)\sqrt{2(32.2)(1230 - 1176) + 2.5)} = \underline{700}$ cfs

1375 cfs.

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
  MODIFIED FOR HONEYWELL APR 79
**********

**********
THIS PROGRAM IS CURRENTLY BEING MODIFIED
TO RUN ON THE OGS HONEYWELL SYSTEM

PLEASE REPORT ANY UNUSUAL OPERATING PROBLEMS
TO MIKE TILLSON (MN. 423) PH: 7-5666
**********
    1          A1   TORONTO RESERVOIR
    2          A2    PHASE I
    3          A2    PMF
    4          B    200       0      30       0       0       0       0       0       0       0
    5          B1     5

    6          J      1       2       1

    7          J1    .5       1

    8          K      0       1                       2               1

    9          K1   INFLOW TO RESERVOIR

   10          M      1       1   23.2    23.2

   11          P             21.0     101     114     124     131

   12          T                                                      1      .1

   13          W    5.9    .625

   14          X   -2.0    -.05       1

   15          K      1       1                       2               1

   16          K1   ROUTE THROUGH RES./FLASHBOARDS FAIL @ 1223.

   17          Y                                  1       1

   18          Y1     1                                                -1220.0      -1

   19          Y4  1220    1222  1222.9    1223    1224    1225    1230

   20          Y5     0     420     800    3600    4300    5000    8715

   21          $S 21850   23920   25300   26680   28750

   22          $E  1215    1218    1220    1222    1225

   23          $$  1215

   24          $D  1230       3     1.5    1500

   25          K     99

   26          A
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	1
END OF NETWORK	

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
  MODIFIED FOR HONEYWELL APR 79
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**********
THIS PROGRAM IS CURRENTLY BEING MODIFIED
TO RUN ON THE OGS HONEYWELL SYSTEM

PLEASE REPORT ANY UNUSUAL OPERATING PROBLEMS
TO MIKE TILLSON (RM. 423) PH1 7-5666
**********

RUN  DATE 01/17/80
                    TORONTO RESERVOIR
                     PHASE 1
                     PMF

                                JOB SPECIFICATION
      NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
     200        0       30        0        0        0        0        0        0        0
                                JOPER      NWT    LROPT    TRACE
                                    5        0        0        0


                            MULTI-PLAN ANALYSES TO BE PERFORMED
                                NPLAN= 1 NRTIO= 2 LRTIO= 1
                RTIOS=    0.50    1.00


**********          **********          **********          **********          **********

                            SUB-AREA RUNOFF COMPUTATION

            INFLOW TO RESERVOIR
                      ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                          1       0       0       0       2       0       1       0       0

                                HYDROGRAPH DATA
          IHYDG    IUHG    TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
              1       1   23.20   23.20   23.20    0.      0.          0       0       0

                                PRECIP DATA
                       SPFE     PMS      R6      R12     R24     R48     R72     R96
                       0.     21.00   101.00   114.00  124.00  131.00    0.      0.
TRSPC COMPUTED BY THE PROGRAM IS 0.828

                                LOSS DATA
          LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
              0    0.      0.      1.00    0.      0.      1.00    1.00    0.10    0.      0.

                            UNIT HYDROGRAPH DATA
                        TP=  5.90    CP=0.63    NTA=  0

                                RECESSION DATA
                            STRTQ=   -2.00    QRCSN=   -0.05    RTIOR= 1.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=13.01 AND R=11.11 INTERVALS

            UNIT HYDROGRAPH 66 END-OF-PERIOD ORDINATES, LAG=  5.86 HOURS, CP= 0.62  VOL= 1.00
```

1[illegible].	[illegible].	[illegible].	1495.	1366.	1246.	1141.	1043.	953.	871.
7[illegible].	727.	65[illegible].	607.	555.	507.	463.	424.	387.	354.
9[illegible].	295.	27[illegible].	247.	225.	206.	188.	172.	157.	144.
1[illegible].	12[illegible].	11[illegible].	10[illegible].	92.	84.	76.	70.	64.	58.
5[illegible].	47.	43.	41.	37.	34.	31.	28.	26.	24.
2[illegible].	20.	18.	17.	15.	14.				

END-OF-PERIOD FLOW

JUL.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	JUL.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	0.30	1	0.00	0.	0.00	46.	1.03	2.30	101	0.	0.	0.	12616.
1.01	1.00	2	0.00	0.	0.00	46.	1.03	3.00	102	0.	0.	0.	11591.
1.01	1.30	3	0.00	0.	0.00	46.	1.03	3.30	103	0.	0.	0.	10644.
1.01	2.00	4	0.00	0.	0.00	46.	1.03	4.00	104	0.	0.	0.	9769.
1.01	2.30	5	0.00	0.	0.00	46.	1.03	4.30	105	0.	0.	0.	8959.
1.01	3.00	6	0.00	0.	0.00	46.	1.03	5.00	106	0.	0.	0.	8210.
1.01	3.30	7	0.00	0.	0.00	46.	1.03	5.30	107	0.	0.	0.	7518.
1.01	4.00	8	0.00	0.	0.00	46.	1.03	6.00	108	0.	0.	0.	6880.
1.01	4.30	9	0.00	0.	0.00	46.	1.03	6.30	109	0.	0.	0.	6293.
1.01	5.00	10	0.00	0.	0.00	46.	1.03	7.00	110	0.	0.	0.	5755.
1.01	5.30	11	0.00	0.	0.00	46.	1.03	7.30	111	0.	0.	0.	5263.
1.01	6.00	12	0.00	0.	0.00	46.	1.03	8.00	112	0.	0.	0.	4813.
1.01	6.30	13	0.01	0.	0.01	46.	1.03	8.30	113	0.	0.	0.	4403.
1.01	7.00	14	0.01	0.	0.01	46.	1.03	9.00	114	0.	0.	0.	4027.
1.01	7.30	15	0.01	0.	0.01	46.	1.03	9.30	115	0.	0.	0.	3684.
1.01	8.00	16	0.01	0.	0.01	46.	1.03	10.00	116	0.	0.	0.	3371.
1.01	8.30	17	0.01	0.	0.01	46.	1.03	10.30	117	0.	0.	0.	3084.
1.01	9.00	18	0.01	0.	0.01	46.	1.03	11.00	118	0.	0.	0.	2823.
1.01	9.30	19	0.01	0.	0.01	46.	1.03	11.30	119	0.	0.	0.	2583.
1.01	10.00	20	0.01	0.	0.01	46.	1.03	12.00	120	0.	0.	0.	2365.
1.01	10.30	21	0.01	0.	0.01	46.	1.03	12.30	121	0.	0.	0.	2165.
1.01	11.00	22	0.01	0.	0.01	46.	1.03	13.00	122	0.	0.	0.	1982.
1.01	11.30	23	0.01	0.	0.01	46.	1.03	13.30	123	0.	0.	0.	1815.
1.01	12.00	24	0.01	0.	0.01	46.	1.03	14.00	124	0.	0.	0.	1663.
1.01	12.30	25	0.05	0.	0.05	46.	1.03	14.30	125	0.	0.	0.	1524.
1.01	13.00	26	0.05	0.	0.05	46.	1.03	15.00	126	0.	0.	0.	1396.
1.01	13.30	27	0.06	0.	0.06	46.	1.03	15.30	127	0.	0.	0.	1283.
1.01	14.00	28	0.06	0.	0.06	46.	1.03	16.00	128	0.	0.	0.	1283.
1.01	14.30	29	0.07	0.	0.07	46.	1.03	16.30	129	0.	0.	0.	1283.
1.01	15.00	30	0.07	0.	0.07	46.	1.03	17.00	130	0.	0.	0.	1283.
1.01	15.30	31	0.09	0.	0.09	46.	1.03	17.30	131	0.	0.	0.	1283.
1.01	16.00	32	0.29	0.	0.29	46.	1.03	18.00	132	0.	0.	0.	1283.
1.01	16.30	33	0.07	0.	0.07	46.	1.03	18.30	133	0.	0.	0.	1283.
1.01	17.00	34	0.07	0.01	0.06	47.	1.03	19.00	134	0.	0.	0.	1283.
1.01	17.30	35	0.05	0.00	0.05	49.	1.03	19.30	135	0.	0.	0.	1283.
1.01	18.00	36	0.05	0.00	0.05	51.	1.03	20.00	136	0.	0.	0.	1283.
1.01	18.30	37	0.00	0.	0.00	55.	1.03	20.30	137	0.	0.	0.	1283.
1.01	19.00	38	0.00	0.	0.00	59.	1.03	21.00	138	0.	0.	0.	1283.
1.01	19.30	39	0.00	0.	0.00	63.	1.03	21.30	139	0.	0.	0.	1283.
1.01	20.00	40	0.00	0.	0.00	68.	1.03	22.00	140	0.	0.	0.	1283.
1.01	20.30	41	0.00	0.	0.00	72.	1.03	22.30	141	0.	0.	0.	1283.
1.01	21.00	42	0.00	0.	0.00	76.	1.03	23.00	142	0.	0.	0.	1283.
1.01	21.30	43	0.00	0.	0.00	79.	1.03	23.30	143	0.	0.	0.	1283.
1.01	22.00	44	0.00	0.	0.00	81.	1.04	0.	144	0.	0.	0.	1283.
1.01	22.30	45	0.00	0.	0.00	83.	1.04	0.30	145	0.	0.	0.	1283.
1.01	23.00	46	0.00	0.	0.00	83.	1.04	1.00	146	0.	0.	0.	1283.
1.01	23.30	47	0.00	0.	0.00	81.	1.04	1.30	147	0.	0.	0.	1283.
1.02	0.	48	0.00	0.	0.00	79.	1.04	2.00	148	0.	0.	0.	1283.
1.02	0.30	49	0.06	0.01	0.05	77.	1.04	2.30	149	0.	0.	0.	1283.
1.02	1.00	50	0.06	0.01	0.05	75.	1.04	3.00	150	0.	0.	0.	1283.
1.02	1.30	51	0.06	0.01	0.05	75.	1.04	3.30	151	0.	0.	0.	1283.
1.02	2.00	52	0.06	0.01	0.05	77.	1.04	4.00	152	0.	0.	0.	1283.
1.02	2.30	53	0.06	0.01	0.05	80.	1.04	4.30	153	0.	0.	0.	1283.
1.02	3.00	54	0.06	0.01	0.05	85.	1.04	5.00	154	0.	0.	0.	1283.
1.02	3.30	55	0.09	0.01	0.05	92.	1.04	5.30	155	0.	0.	0.	1283.
1.02	4.00	56	0.06	0.01	0.05	101.	1.04	6.00	156	0.	0.	0.	1283.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1.02	5.[illegible]	58	[illegible]	0.01	0.05	121.	1.04	7.00	158	0.	0.	0.	1283.
1.02	5.30	59	0.06	0.01	0.05	133.	1.04	7.30	159	0.	0.	0.	1283.
1.02	[illegible]	60	0.06	0.01	0.05	145.	1.04	8.00	160	0.	0.	0.	1283.
1.02	6.[illegible]	61	0.13	0.14	0.05	161.	1.04	8.30	161	0.	0.	0.	1283.
1.02	7.[illegible]	62	0.19	0.14	0.05	191.	1.04	9.00	162	0.	0.	0.	1283.
1.02	7.[illegible]	63	0.19	0.14	0.05	240.	1.04	9.30	163	0.	0.	0.	1283.
1.02	8.[illegible]	64	0.19	0.14	0.05	311.	1.04	10.00	164	0.	0.	0.	1283.
1.02	8.[illegible]	65	0.19	0.14	0.05	406.	1.04	10.30	165	0.	0.	0.	1283.
1.02	9.[illegible]	66	0.19	0.14	0.05	526.	1.04	11.00	166	0.	0.	0.	1283.
1.02	9.30	67	0.19	0.14	0.05	673.	1.04	11.30	167	0.	0.	0.	1283.
1.02	10.[illegible]	68	0.19	0.14	0.05	844.	1.04	12.00	168	0.	0.	0.	1283.
1.02	10.30	69	0.19	0.14	0.05	1035.	1.04	12.30	169	0.	0.	0.	1283.
1.02	11.[illegible]	70	0.19	0.14	0.05	1239.	1.04	13.00	170	0.	0.	0.	1283.
1.02	11.[illegible]	71	0.19	0.14	0.05	1452.	1.04	13.30	171	0.	0.	0.	1283.
1.02	12.00	72	0.19	0.14	0.05	1668.	1.04	14.00	172	0.	0.	0.	1283.
1.02	12.30	73	0.88	0.83	0.05	1907.	1.04	14.30	173	0.	0.	0.	1283.
1.02	13.00	74	0.88	0.83	0.05	2206.	1.04	15.00	174	0.	0.	0.	1283.
1.02	13.30	75	1.05	1.00	0.05	2598.	1.04	15.30	175	0.	0.	0.	1283.
1.02	14.[illegible]	76	1.05	1.00	0.05	3115.	1.04	16.00	176	0.	0.	0.	1283.
1.02	14.30	77	1.32	1.27	0.05	3786.	1.04	16.30	177	0.	0.	0.	1283.
1.02	15.00	78	1.32	1.27	0.05	4643.	1.04	17.00	178	0.	0.	0.	1283.
1.02	15.[illegible]	79	1.60	1.55	0.05	5716.	1.04	17.30	179	0.	0.	0.	1283.
1.02	16.[illegible]	80	5.07	5.02	0.05	7156.	1.04	18.00	180	0.	0.	0.	1283.
1.02	16.30	81	1.23	1.18	0.05	9040.	1.04	18.30	181	0.	0.	0.	1283.
1.02	17.[illegible]	82	1.23	1.18	0.05	11242.	1.04	19.00	182	0.	0.	0.	1283.
1.02	17.[illegible]	83	0.97	0.92	0.05	13640.	1.04	19.30	183	0.	0.	0.	1283.
1.02	18.[illegible]	84	0.97	0.92	0.05	16138.	1.04	20.00	184	0.	0.	0.	1283.
1.02	18.30	85	0.09	0.04	0.05	18615.	1.04	20.30	185	0.	0.	0.	1283.
1.02	19.[illegible]	86	0.09	0.04	0.05	20905.	1.04	21.00	186	0.	0.	0.	1283.
1.02	19.[illegible]	87	0.09	0.04	0.05	22836.	1.04	21.30	187	0.	0.	0.	1283.
1.02	20.[illegible]	88	0.09	0.04	0.05	24289.	1.04	22.00	188	0.	0.	0.	1283.
1.02	20.[illegible]	89	0.09	0.04	0.05	25232.	1.04	22.30	189	0.	0.	0.	1283.
1.02	21.[illegible]	90	0.09	0.04	0.05	25651.	1.04	23.00	190	0.	0.	0.	1283.
1.02	21.[illegible]	91	0.09	0.04	0.05	25542.	1.04	23.30	191	0.	0.	0.	1283.
1.02	22.[illegible]	92	0.09	0.04	0.05	24900.	1.05	0.	192	0.	0.	0.	1283.
1.02	22.[illegible]	93	0.09	0.04	0.05	23744.	1.05	0.30	193	0.	0.	0.	1283.
1.02	23.[illegible]	94	0.09	0.04	0.05	22289.	1.05	1.00	194	0.	0.	0.	1283.
1.02	23.[illegible]	95	0.09	0.04	0.05	20753.	1.05	1.30	195	0.	0.	0.	1283.
1.03	0.	96	0.09	0.04	0.05	19196.	1.05	2.00	196	0.	0.	0.	1283.
1.03	0.[illegible]	97	0.	0.	0.	17674.	1.05	2.30	197	0.	0.	0.	1283.
1.03	1.[illegible]	98	0.	0.	0.	16246.	1.05	3.00	198	0.	0.	0.	1283.
1.03	1.[illegible]	99	0.	0.	0.	14934.	1.05	3.30	199	0.	0.	0.	1283.
1.03	2.[illegible]	100	0.	0.	0.	13727.	1.05	4.00	200	0.	0.	0.	1283.
									SUM	22.77	19.18	3.59	660319.
										(578.)	(487.)	(91.)	(18698.15)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	25651.	22700.	11302.	4559.	659636.
CMS	726.	645.	320.	129.	18679.
INCHES		9.14	18.13	21.94	22.04
MM		232.11	460.44	557.17	559.84
AC-FT		11301.	22418.	27128.	27258.
THOUS CU M		13939.	27652.	33462.	33622.

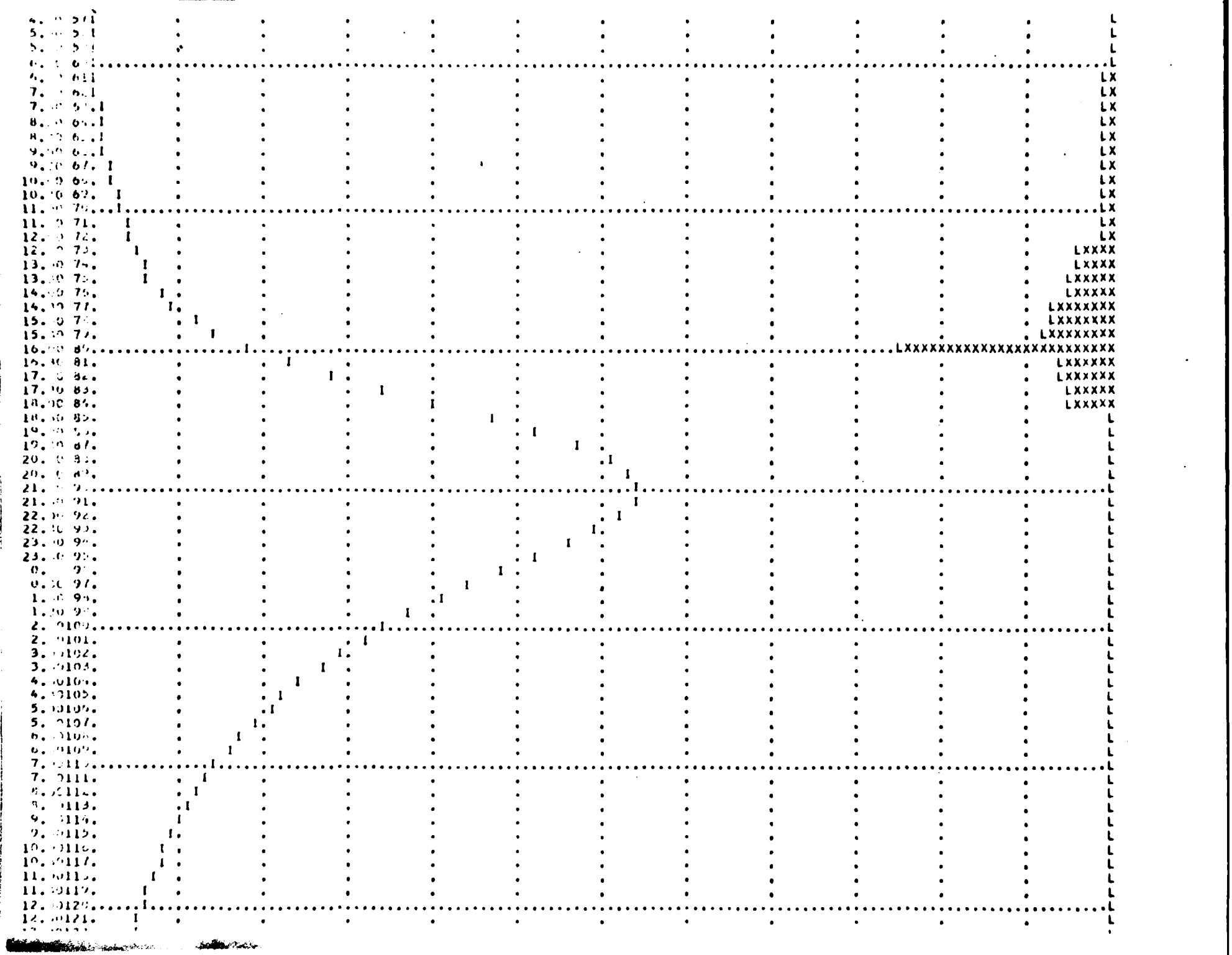
STATION 1

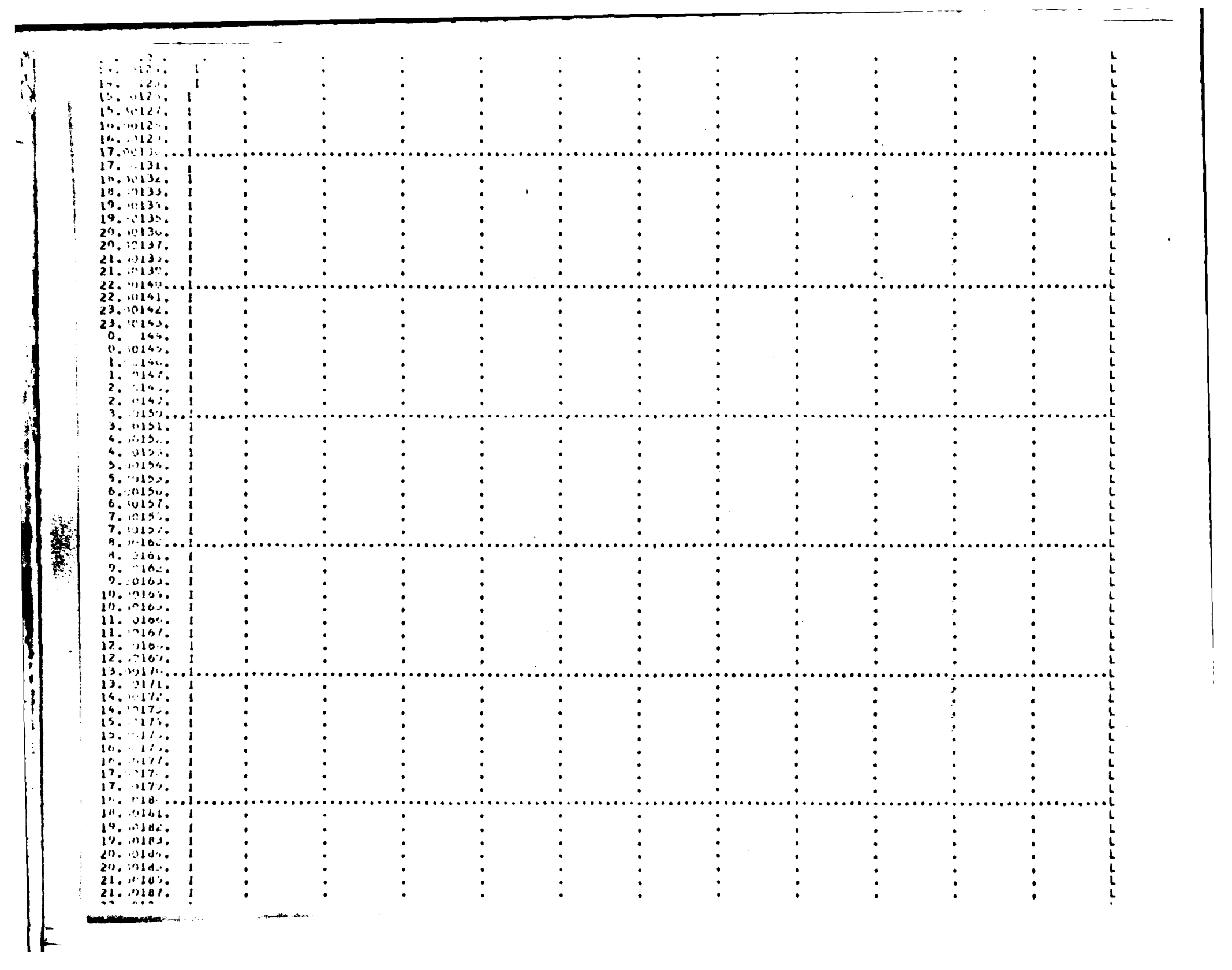
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

0.	4000.	8000.	12000.	16000.	20000.	24000.	28000.	0.	0.	0.	0.	0.

PRECIP(L) AND EXCESS(X)

0.	0.	0.	0.	0.	0.	0.	0.	0.	6.	4.	2.	0.
0.10	1I											L
1.00	2I											L
1.10	3I											L
2.00	4I											L
2.10	5I											L
3.00	6I											L
3.10	7I											L
4.00	8I											L
4.10	9I											L
5.00	10I											L
5.10	11I											L
6.00	12I											L
6.10	13I											L
7.00	14I											L
7.10	15I											L
8.00	16I											L
8.10	17I											L
9.00	18I											L
9.10	19I											L
10.00	20I											L
10.10	21I											L
11.00	22I											L
11.10	23I											L
12.00	24I											L
12.10	25I											L
13.00	26I											L
13.10	27I											L
14.00	28I											L
14.10	29I											L
15.00	30I											L
15.10	31I											L
16.00	32I											LX
16.10	33I											L
17.00	34I											L
17.10	35I											L
18.00	36I											L
18.10	37I											L
19.00	38I											L
19.10	39I											L
20.00	40I											L
20.10	41I											L
21.00	42I											L
21.10	43I											L
22.00	44I											L
22.10	45I											L
23.00	46I											L
23.10	47I											L
0.	48I											L
0.10	49I											L
1.00	50I											L
1.10	51I											L
2.00	52I											L
2.10	53I											L
3.00	54I											L
3.10	55I											L





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                                     HYDROGRAPH AT STA      1 FOR PLAN 1, RTIO 1
       23.         23.         23.         23.         23.         23.         23.         23.         23.         23.
       23.         23.         23.         23.         23.         23.         23.         23.         23.         23.
       23.         23.         23.         23.         23.         23.         23.         23.         23.         23.
       23.         23.         23.         23.         24.         26.         27.         29.         32.         34.
[illegible] [illegible]        40.         41.         41.         41.         41.         39.         38.         38.
[illegible] [illegible]        43.         43.         46.         50.         55.         61.         66.         72.
       81. [illegible]        126.        155.        203.        263.        337.        422.        517.        620.
[illegible] [illegible]       953.       1103.       1297.       1557.       1893.       2321.       2858.       3578.
[illegible]       5621.       6121.       8065.       9307.      10453.      11418.      12145.      12616.      12826.
    12771. [illegible]  [illegible]      11144.      10377.       9598.       8837.       8123.       7467.       6864.
[illegible] [illegible]  [illegible] [illegible]       4472.       4105.       3759.       3440.       3146.       2877.
[illegible]       2437.       2231.       2014.       1842.       1685.       1542.       1411.       1292.       1182.
[illegible] [illegible]  [illegible]        831.        762.        696.        641.        641.        641.        641.
      641.        641.        641.        641.        641.        641.        641.        641.        641.        641.
      641.        641.        641.        641.        641.        641.        641.        641.        641.        641.
      641.        641.        641.        641.        641.        641.        641.        641.        641.        641.
      641.        641.        641.        641.        641.        641.        641.        641.        641.        641.
      641.        641.        641.        641.        641.        641.        641.        641.        641.        641.
      641.        641.        641.        641.        641.        641.        641.        641.        641.        641.
      641.        641.        641.        641.        641.        641.        641.        641.        641.        641.

                               PEAK      6-HOUR     24-HOUR     72-HOUR   TOTAL VOLUME
                    CFS       12826.      11395.       5651.       2279.       329818.
                    CMS         363.        323.        160.         65.         9339.
                 INCHES                     4.57        9.06       10.97         11.02
                     MM                   116.05      230.22      278.58        279.92
                  AC-FT                    5650.      11209.      13564.        13629.
             THOUS CU M                    6970.      13826.      16731.        16811.

                                     HYDROGRAPH AT STA      1 FOR PLAN 1, RTIO 2
[illegible] [illegible]        46.         46.         46.         46.         46.         46.         46.         46.
[illegible] [illegible]        46.         46.         46.         46.         46.         46.         46.         46.
[illegible] [illegible]        46.         46.         46.         46.         46.         46.         46.         46.
[illegible] [illegible] [illegible]        47.         49.         51.         55.         59.         63.         68.
[illegible]        76.         79.         81.         83.         83.         81.         79.         77.         75.
[illegible]        77.         80.         85.         92.        101.        110.        121.        133.        145.
      151. [illegible]        240.        311.        406.        526.        673.        844.       1035.       1239.
     1452. [illegible]  [illegible]       2206.       2598.       3115.       3786.       4643.       5716.       7156.
[illegible]      11292.      13649.      16138.      18615.      20905.      22836.      24289.      25232.      25651.
[illegible] [illegible]      23744.      22289.      20753.      19196.      17674.      16246.      14934.      13727.
[illegible] [illegible]  [illegible]       9769.       8959.       8210.       7518.       6880.       6293.       5755.
[illegible] [illegible]  [illegible]       4027.       3684.       3371.       3084.       2823.       2583.       2365.
[illegible] [illegible]  [illegible]       1663.       1524.       1396.       1283.       1283.       1283.       1283.
[illegible] [illegible]  [illegible]       1283.       1283.       1283.       1283.       1283.       1283.       1283.
[illegible]       1283.  [illegible]       1283.       1283.       1283.       1283.       1283.       1283.       1283.
[illegible]       1283.  [illegible]       1283.       1283.       1283.       1283.       1283.       1283.       1283.
[illegible] [illegible]  [illegible]       1283.       1283.       1283.       1283.       1283.       1283.       1283.
[illegible] [illegible]        1283.       1283.       1283.       1283.       1283.       1283.       1283.       1283.
[illegible] [illegible]        1283.       1283.       1283.       1283.       1283.       1283.       1283.       1283.
[illegible] [illegible]        1283.       1283.       1283.       1283.       1283.       1283.       1283.       1283.

                               PEAK      6-HOUR     24-HOUR     72-HOUR   TOTAL VOLUME
                    CFS       25651. [illegible]     11302.       4559.       659636.
                    CMS         725.        645.        320.        129.        18679.
                 INCHES                     9.14       18.13       21.94         22.04
                     MM                   232.11      460.44      557.17        559.84
                  AC-FT              [illegible]      22416.      27128.        27258.
             THOUS CU M              [illegible]      27652.      33462.        33622.
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HYDROGRAPH ROUTING

ROUTE THROUGH RES./FLASHBOARDS FAIL @ 1223.

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.	0.	0.	1	1	0	0	0

NSTPS	ITSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.	0.	0.	-1220.	-1

STAGE	1220.00	1222.00	1222.50	1223.00	1224.00	1225.00	1230.00
FLOW	0.	920.00	600.00	3600.00	4300.00	5000.00	8715.00
CAPACITY=	21350.	23920.	25300.	26680.	28750.		
ELEVATION=	1215.	1217.	1220.	1222.	1225.		

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1215.0	0.	0.	0.	0.	0.	0.	0.

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1230.0	3.0	1.5	1500.

WARNING *** TOP OF DAM, BOTTOM OF RESERVOIR OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 1215.00
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 1225.00

STATION 1, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	1.	1.	1.	1.	2.	2.	2.	2.	3.
3.	4.	3.	4.	4.	4.	4.	5.	5.	5.
5.	5.	6.	6.	6.	6.	7.	7.	7.	7.
7.	8.	8.	8.	8.	8.	9.	9.	9.	10.
10.	10.	11.	11.	11.	12.	12.	12.	13.	13.
13.	14.	14.	14.	15.	15.	16.	16.	17.	17.
18.	19.	20.	22.	24.	26.	30.	34.	39.	46.
56.	68.	81.	95.	99.	110.	136.	161.	191.	229.
279.	338.	413.	575.	778.	3812.	4104.	4419.	4746.	5076.
5414.	5727.	6007.	6247.	6443.	6597.	6712.	6789.	6832.	6847.
6839.	6811.	6767.	6678.	6539.	6483.	6378.	6257.	6128.	5992.
5851.	5708.	5564.	5409.	5256.	5104.	4955.	4812.	4670.	4529.
4389.	4252.	4119.	3988.	3862.	3724.	3590.	962.	796.	792.
787.	781.	781.	778.	775.	771.	768.	765.	762.	759.
756.	753.	750.	748.	745.	742.	740.	737.	735.	733.
730.	728.	726.	724.	722.	720.	718.	716.	714.	712.
711.	709.	707.	706.	704.	702.	701.	699.	698.	697.
695.	694.	693.	691.	690.	689.	688.	687.	685.	684.
683.	682.	681.	680.	679.	678.	677.	676.	676.	675.
674.	673.	672.	672.	671.	670.	669.	669.	668.	667.

STORAGE

25301.	25302.	25303.	25304.	25305.	25306.	25306.	25307.	25308.	25309.
25310.	25311.	25311.	25312.	25313.	25314.	25315.	25315.	25316.	25317.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25328.	25329.	25329.	25330.	25331.
25332.	25333.	25335.	25336.	25337.	25338.	25340.	25341.	25342.	25343.
25344.	25345.	25346.	25347.	25348.	25350.	25351.	25353.	25355.	25357.
25359.	25361.	25363.	25371.	25377.	25386.	25397.	25411.	25429.	25451.
25477.	25507.	25541.	25580.	25626.	25680.	25746.	25827.	25927.	26051.
[illegible]	[illegible]	[illegible]	[illegible]	27265.	27579.	27867.	28170.	28500.	28822.
29113.	29382.	29615.	29808.	30090.	30234.	30340.	30411.	30452.	30465.
30459.	30433.	30373.	30306.	30226.	30133.	30029.	29917.	29797.	29671.
29541.	29406.	29267.	29126.	28988.	28847.	28706.	28565.	28425.	28286.
28148.	28013.	27879.	27748.	27619.	27492.	27370.	27305.	27295.	27269.
27244.	27277.	27271.	27265.	27260.	27254.	27249.	27244.	27239.	27234.
27227.	27224.	27220.	27215.	27211.	27207.	27203.	27199.	27195.	27191.
27187.	27184.	27180.	27177.	27173.	27170.	27167.	27164.	27161.	27158.
27155.	27152.	27149.	27147.	27144.	27142.	27139.	27137.	27134.	27132.
27130.	27128.	27125.	27123.	27121.	27119.	27117.	27116.	27114.	27112.
2711 .	27107.	27107.	27105.	27104.	27102.	27101.	27099.	27098.	27096.
27095.	27094.	27092.	27091.	27090.	27089.	27087.	27086.	27085.	27084.

STAGE

1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0
1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0
1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0
1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0	1220.0
1220.0	1220.0	1220.1	1220.1	1220.1	1220.1	1220.1	1220.1	1220.1	1220.1
1220.1	1220.1	1220.1	1220.1	1220.1	1220.1	1220.1	1220.1	1220.1	1220.1
1220.1	1220.1	1220.1	1220.1	1220.1	1220.1	1220.1	1220.2	1220.2	1220.2
1220.3	1220.3	1220.4	1220.4	1220.5	1220.6	1220.6	1220.8	1220.9	1221.1
1221.3	1221.6	1222.0	1222.4	1222.8	1223.3	1223.7	1224.2	1224.6	1225.1
1225.6	1226.0	1226.4	1226.7	1226.9	1227.2	1227.3	1227.4	1227.5	1227.5
1227.5	1227.4	1227.4	1227.3	1227.1	1227.0	1226.9	1226.7	1226.5	1226.3
1226.1	1225.9	1225.7	1225.5	1225.3	1225.1	1224.9	1224.7	1224.5	1224.3
1224.1	1223.9	1223.7	1223.5	1223.4	1223.2	1223.0	1222.9	1222.9	1222.9
1222.9	1222.9	1222.8	1222.8	1222.8	1222.8	1222.8	1222.8	1222.8	1222.8
1222.8	1222.8	1222.8	1222.8	1222.8	1222.8	1222.8	1222.8	1222.7	1222.7
1222.7	1222.7	1222.7	1222.7	1222.7	1222.7	1222.7	1222.7	1222.7	1222.7
1222.7	1222.7	1222.7	1222.7	1222.7	1222.7	1222.7	1222.7	1222.7	1222.7
1222.7	1222.8	1222.8	1222.6	1222.6	1222.6	1222.6	1222.6	1222.6	1222.6
1222.6	1222.6	1222.6	1222.6	1222.6	1222.6	1222.6	1222.6	1222.6	1222.6
1222.6	1222.6	1222.6	1222.6	1222.6	1222.6	1222.6	1222.6	1222.6	1222.6

PEAK OUTFLOW IS 6847. AT TIME 55.00 HOURS

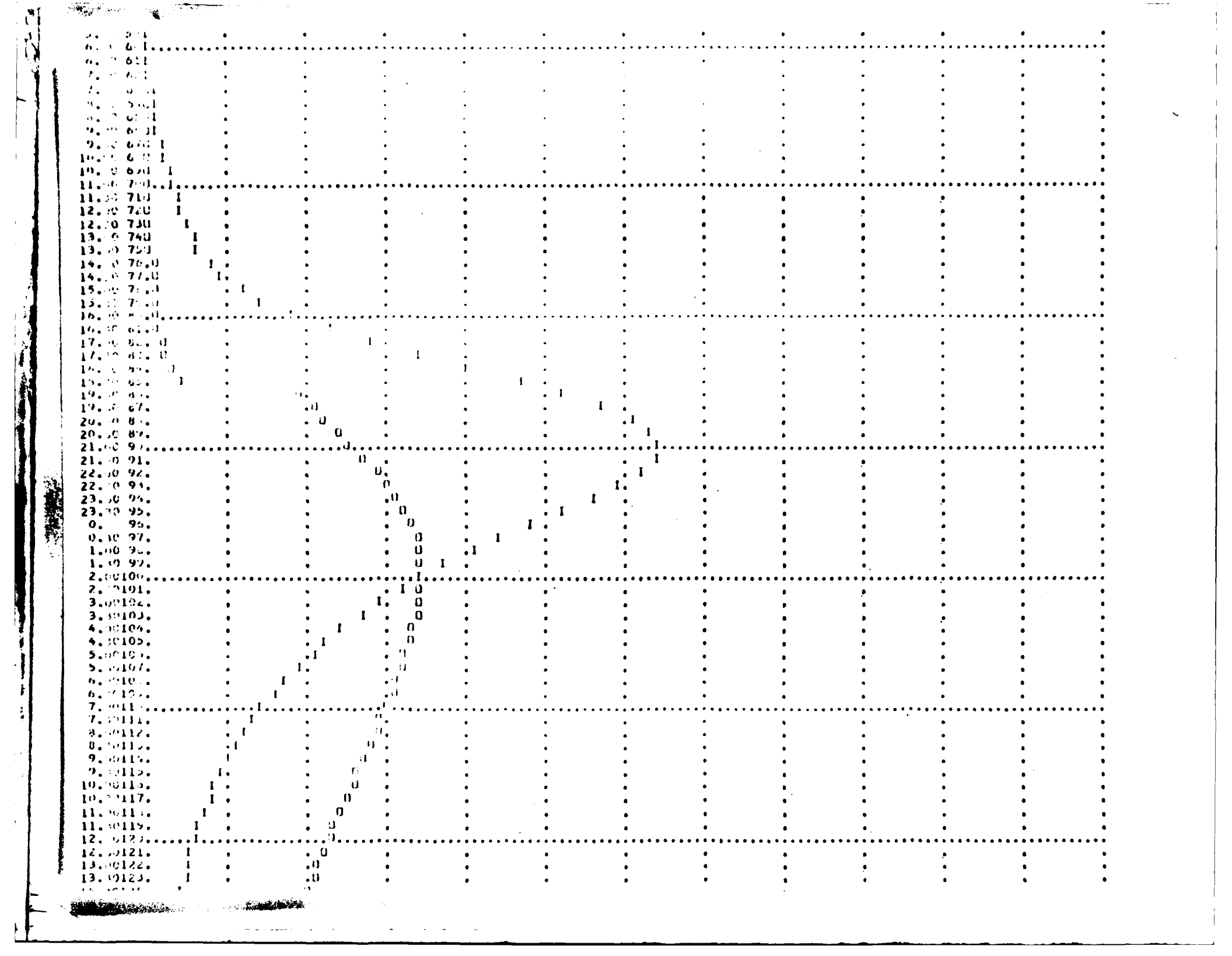
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6847.	6694.	4903.	1989.	286780.
CMS	194.	190.	139.	56.	8121.
INCHES		2.63	7.80	9.57	9.58
MM		68.17	199.73	243.06	243.39
AC-FT		3319.	9724.	11834.	11850.
THOUS CU M		4094.	11995.	14597.	14617.

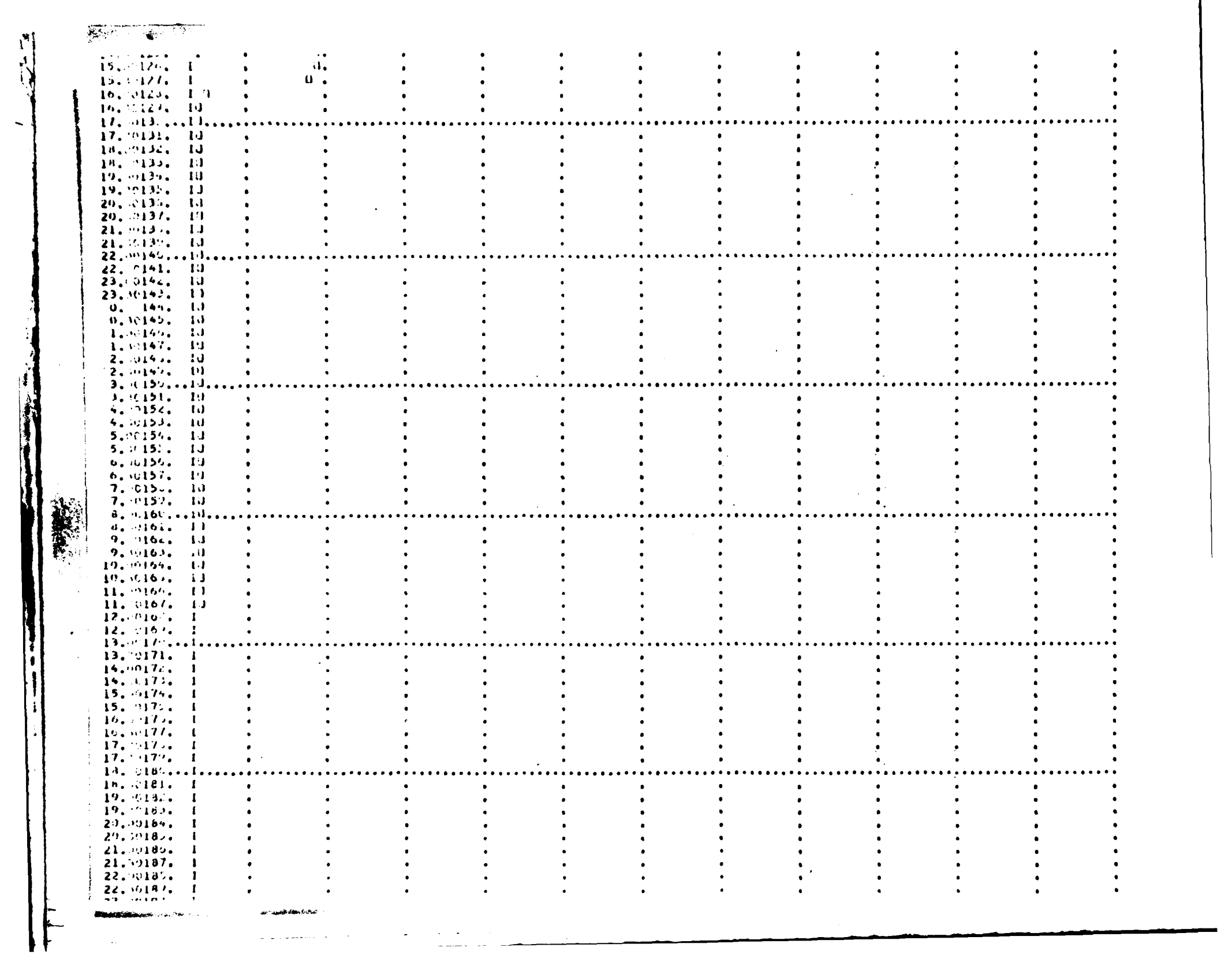
HYD

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	2000.	4000.	6000.	8000.	10000.	12000.	14000.	0.	0.	0.	0.	0.
0.30	11												
1.00	21												
1.30	31												
2.00	41												
2.30	51												
3.00	61												
3.30	71												
4.00	81												
4.30	91												
5.00	101												
5.30	111												
6.00	121												
6.30	131												
7.00	141												
7.30	151												
8.00	161												
8.30	171												
9.00	181												
9.30	191												
10.00	201												
10.30	211												
11.00	221												
11.30	231												
12.00	241												
12.30	251												
13.00	261												
13.30	271												
14.00	281												
14.30	291												
15.00	301												
15.30	311												
16.00	321												
16.30	331												
17.00	341												
17.30	351												
18.00	361												
18.30	371												
19.00	381												
19.30	391												
20.00	401												
20.30	411												
21.00	421												
21.30	431												
22.00	441												
22.30	451												
23.00	461												
23.30	471												
0.	481												
0.30	491												
1.00	501												
1.30	511												
2.00	521												
2.30	531												
3.00	541												
3.30	551												
4.00	561												
4.30	571												





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*****

WARNING *** TOP OF DAM, [illegible] OF LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
            BOTTOM OF RESERVOIR ASSUMED TO BE AT 1215.00
            STORAGE-ELEVATION DATA WILL BE EXTRAPULATED ABOVE ELEVATION 1225.00

                                         STATION      1, PLAN 1, RATIO 2

                                      END-OF-PERIOD HYDROGRAPH ORDINATES

                                                   OUTFLOW
      1.        1.        2.        2.        3.        3.        4.        4.        5.        5.
      6.        7.        7.        7.        8.        8.        9.        9.       10.       10.
     11.       11.       12.       12.       13.       13.       13.       14.       14.       15.
     15.       15.       16.       16.       17.       17.       17.       18.       18.       19.
     20.       20.       21.       22.       23.       23.       24.       25.       25.       26.
     27.       27.       28.       29.       29.       30.       31.       32.       33.       35.
     35.       38.       40.       43.       47.       52.       59.       68.       79.       92.
    101.      120.      147.      170.      198.      232.      272.      321.      382.      495.
[illegible] [illegible] [illegible] [illegible] [illegible] 5651. 6356.     7105.     7874.     8639.
[illegible] [illegible] [illegible] [illegible] 21556. [illegible] 19756. 18534.  17293.    16086.
[illegible] [illegible] [illegible] [illegible] 11172. 11142. 9756.      9204.     8779.     9625.
[illegible] [illegible] [illegible] [illegible] 7321.  7537.  7445.      7249.     7351.     6852.
   5652. [illegible] [illegible] [illegible] [illegible] 5677. 5484.     5301.     5126.     4961.
[illegible] [illegible] [illegible] [illegible] [illegible] 4143. 4025.  3913.     3105.     3701.
   3002.  [illegible] [illegible]  1276.     1281.     1236.     1284.     1284.     1283.     1263.
   1283.     1283.     1243.     1285.     1283.     1233.     1283.     1283.     1283.     1283.
   1283.     1283.     1283.     1283.     1283.     1283.     1283.     1283.     1283.     1283.
   1283.     1283.     1283.     1283.     1283.     1283.     1283.     1283.     1283.     1283.
   1283.     1293.     1253.     1283.     1283.     1283.     1283.     1283.     1233.     1283.
   1283.     1283.     1283.     1243.     1283.     1283.     1283.     1283.     1283.     1283.

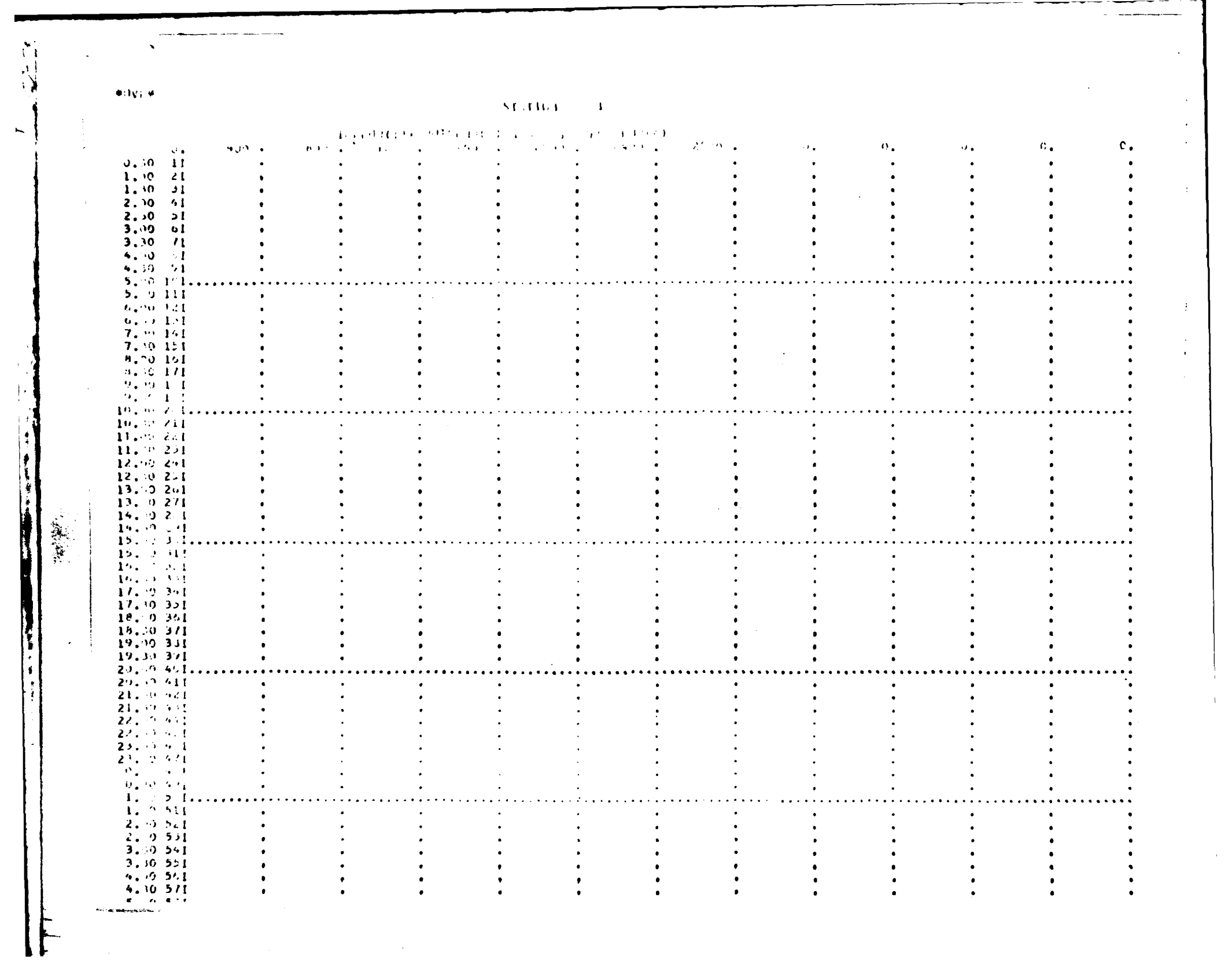
                                                   STORAGE
[illegible] [illegible] [illegible] 25307. 25309. [illegible] 25313.  25315.    25316.    25318.
[illegible] [illegible] 25323. 25325. [illegible] [illegible] 25326.  25331.    25332.    25334.
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] 25345. 25347. [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] 25357. 25357. 25361. 25363.
  25365.    25367. [illegible] 25372.   25374.    25377.    25379.    25381.    25384.    25386.
[illegible] [illegible] [illegible] 25394. 25396.   25399.    25402.    25406.    25410.    25414.
  25417.    25425.    25432.    25442.    25455.    25472.    25494.    25523.    25559.    25602.
  25654.    25713.    25782.    25860.    25952.    26061.    26193.    26355.    26554.    26802.
  27112.    27441.    27796.    28236.    28758.    29354.    30010.    30705.    31419.    32129.
  32759.    33176.    33402.    33487.    33486.    33436.    33359.    33269.    33173.    33075.
  32979.    32863.    32789.    32696.    32605.    32513.    32421.    32326.    32227.    32116.
  31990.    31851.    31700.    31546.    31372.    31199.    31020.    30839.    30655.    30470.
[illegible] [illegible] 29919. 29739.   29552.    29374.    29199.    29029.    28867.    28712.
[illegible] [illegible] [illegible] [illegible] [illegible] 27905. 27799. 27678.  27572.    27470.
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] 27313. 27313.
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] 27313. 27313.
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] 27313. 27313.
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] 27313. 27313. 27313.
[illegible] [illegible] [illegible] [illegible] 27313. [illegible] 27313.  27313.    27313.    27313.
[illegible] [illegible] 27313. [illegible] 27313. [illegible] 27313.      27313.    27313.    27313.

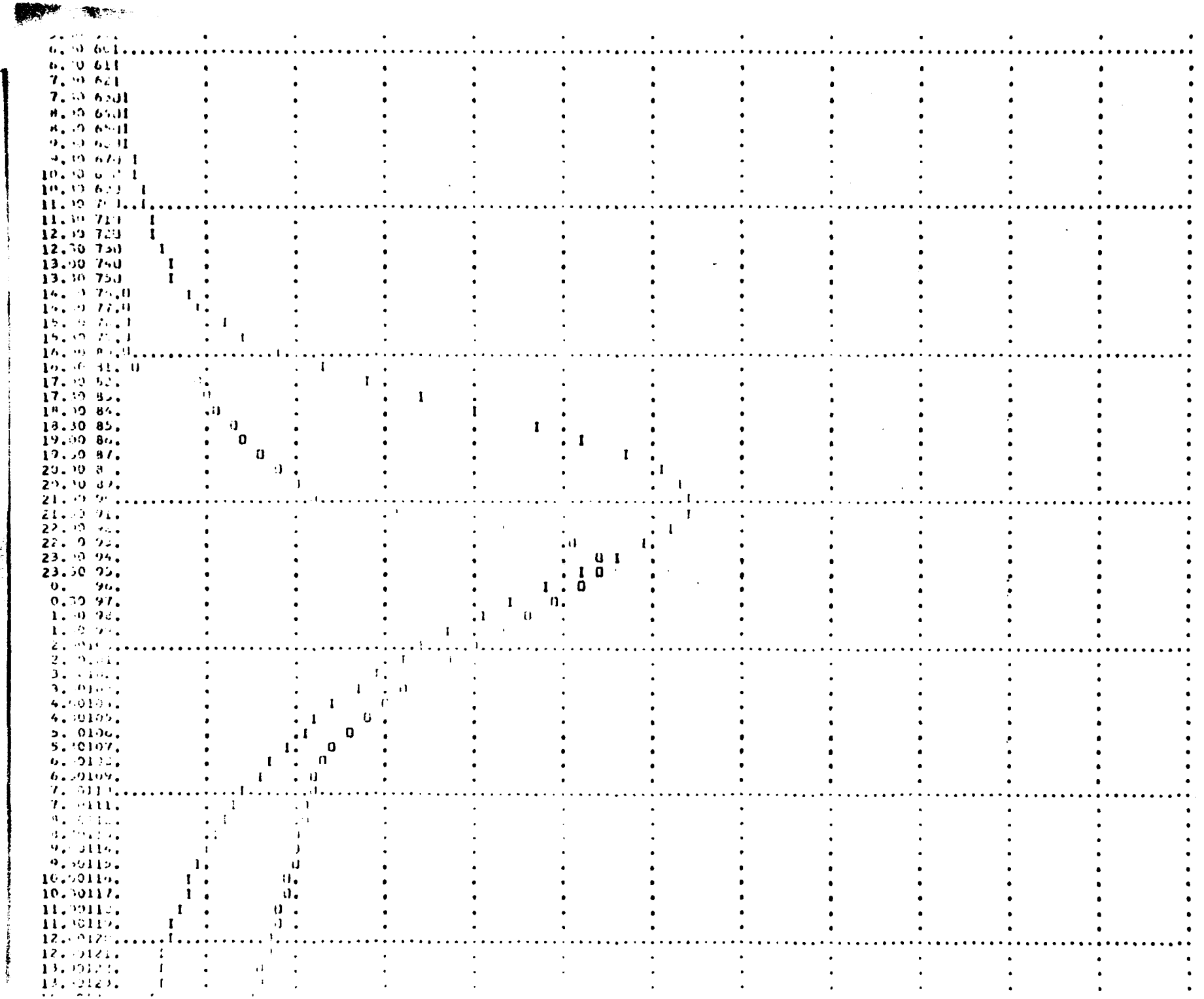
                                                    STAGE
 1220.0    1220.0    1220.0    1220.0    1220.0    1220.0    1220.0    1220.0    1220.0    1220.0
 1220.0    1220.0    1220.0    1220.0    1220.0    1220.0    1220.0    1220.0    1220.0    1220.0
 1220.1    1220.1    1220.1    1220.1    1220.1    1220.1    1220.1    1220.1    1220.1    1220.1
 1220.1    1220.1    1220.1    1220.1    1220.1    1220.1    1220.1    1220.1    1220.1    1220.1
 1220.1    1220.1    1220.1    1220.1    1220.1    1220.1    1220.1    1220.1    1220.1    1220.1
 1220.1    1220.1    1220.1 [illegible] [illegible] 1220.1  1220.1    1220.2    1220.2    1220.2
 1220.2 [illegible] [illegible] [illegible] [illegible] [illegible] 1220.2 1220.3  1220.4    1220.4
```

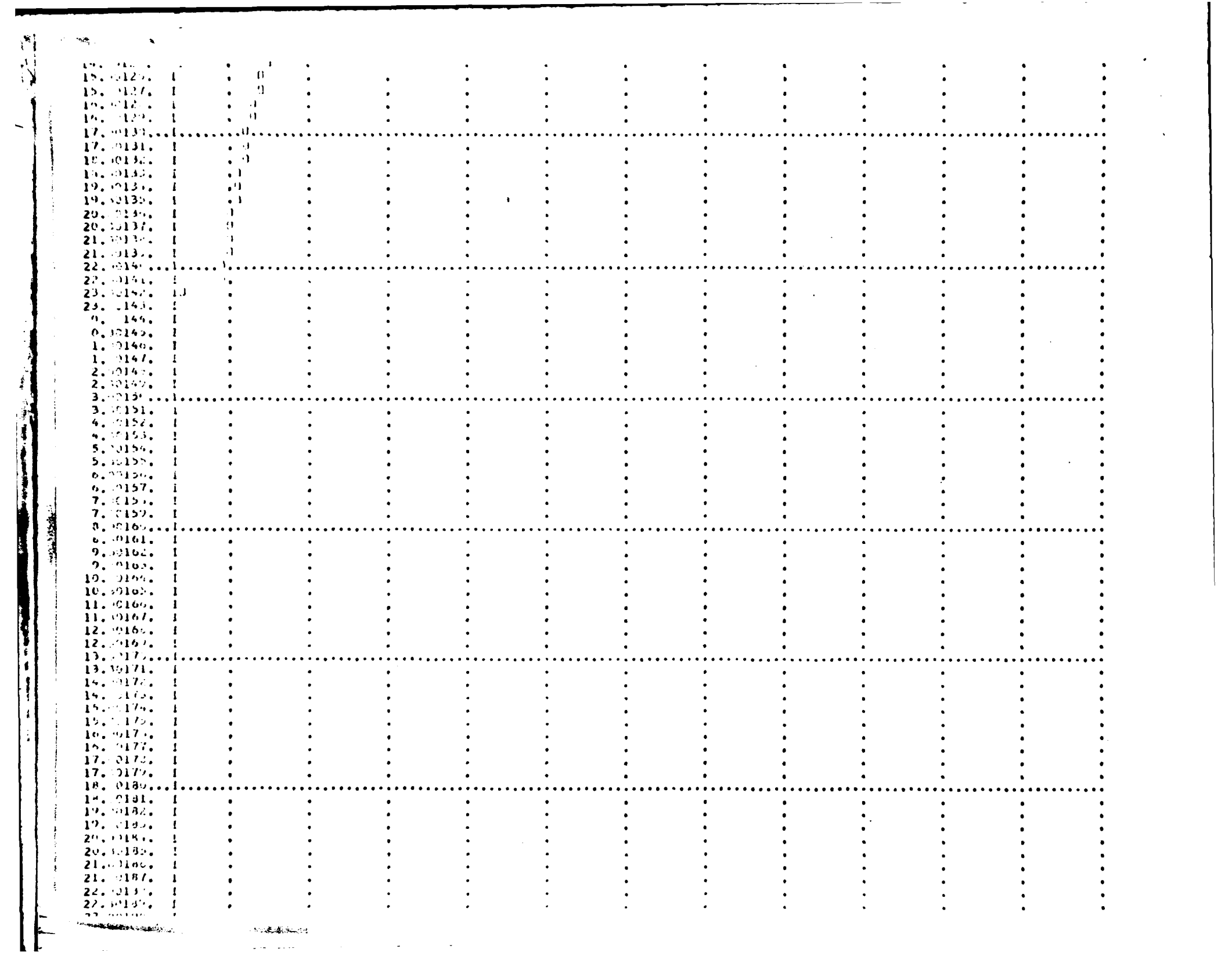
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1231.1	1231.0	1230.8	1230.7	1230.6	1230.5	1230.3	1230.2	1230.0	1229.9
1229.7	1229.5	1229.3	1229.0	1228.8	1228.5	1228.3	1228.0	1227.8	1227.5
1227.2	1227.0	1226.7	1226.4	1226.2	1225.9	1225.7	1225.4	1225.2	1224.9
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9
1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9
1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9
1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9	1222.9

PEAK OUTFLOW IS 21563. AT TIME 47.00 HOURS

	[illegible]	[illegible]	[illegible]	[illegible]	TOTAL [illegible]
CFS	[illegible]	[illegible]	[illegible]	4258.	[illegible]
CMS	611.	507.	285.	120.	17302.
INCHES		7.13	16.12	20.39	20.42
MM		182.33	409.42	517.90	518.57
AC-FT		8877.	19934.	25216.	25249.
THOUS CU M		10950.	24589.	31103.	31144.







PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 0.50	RATIO 2 1.00
HYDROGRAPH AT	1	23.20	1	12326.	25451.
	(	0.60)	(	349.1)(	720.3)(
ROUTED TO	1	23.20	1	5347.	21563.
	(	0.00)	(	151.4)(	610.5)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1220.00	1215.00	1230.00
STORAGE	25300.	21450.	32200.
OUTFLOW	0.	0.	8715.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.50	1227.49	0.	30465.	6847.	0.	50.00	0.
1.00	1231.87	1.87	33487.	21563.	9.50	47.00	0.

APPENDIX D

REFERENCES

APPENDIX D

REFERENCES

1) U.S. Department of Commerce, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, May 1961.

2) Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology, August 1972 (U.S. Department of Agriculture).

3) H.W. King and E.F. Brater, Handbook of Hydraulics, 5th edition, McGraw-Hill, 1963.

4) T.W. Lambe and R.V. Whitman, Soil Mechanics, John Wiley and Sons, 1965.

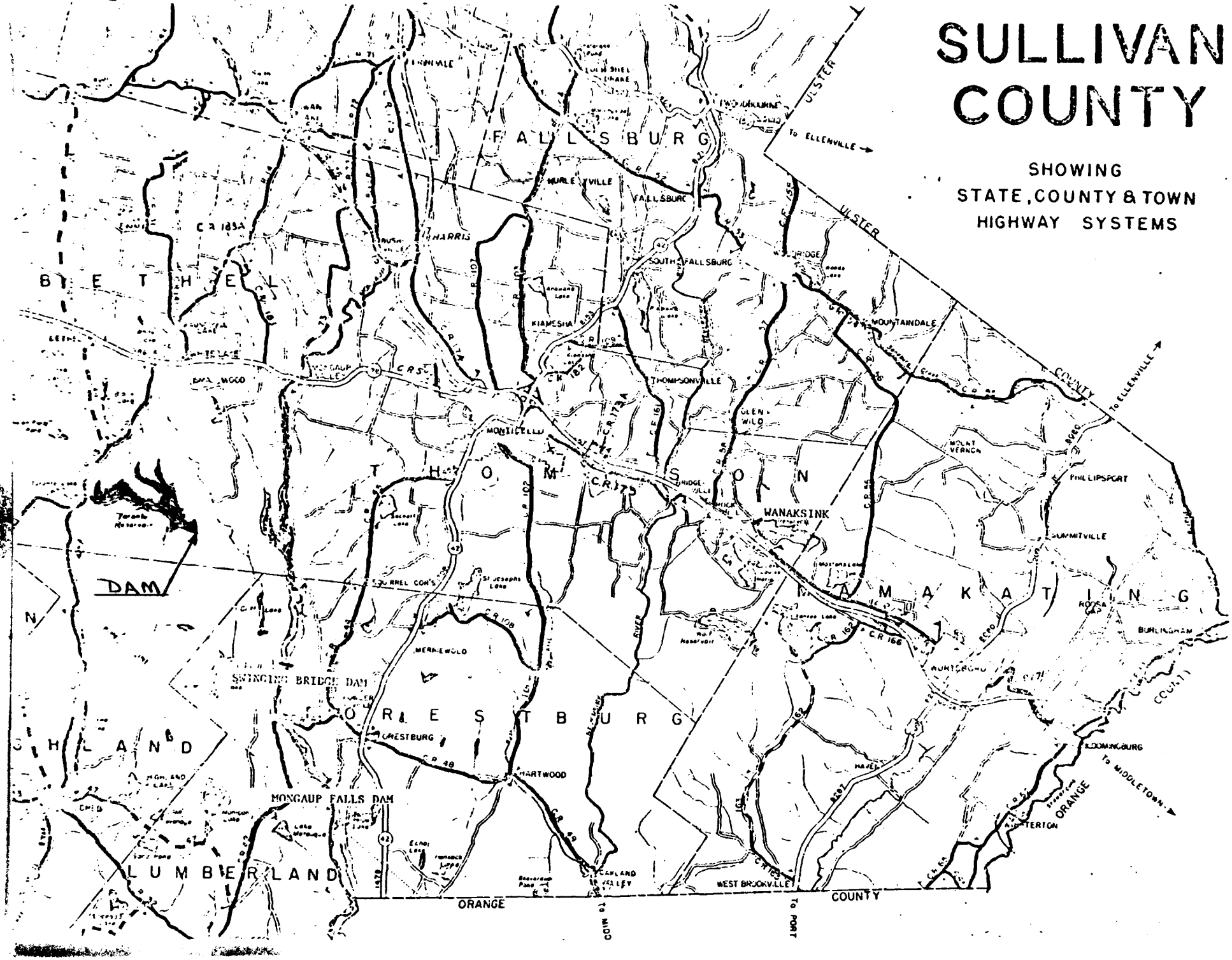
5) W.D. Thornbury, Principles of Geomorphology, John Wiley and Sons, 1969.

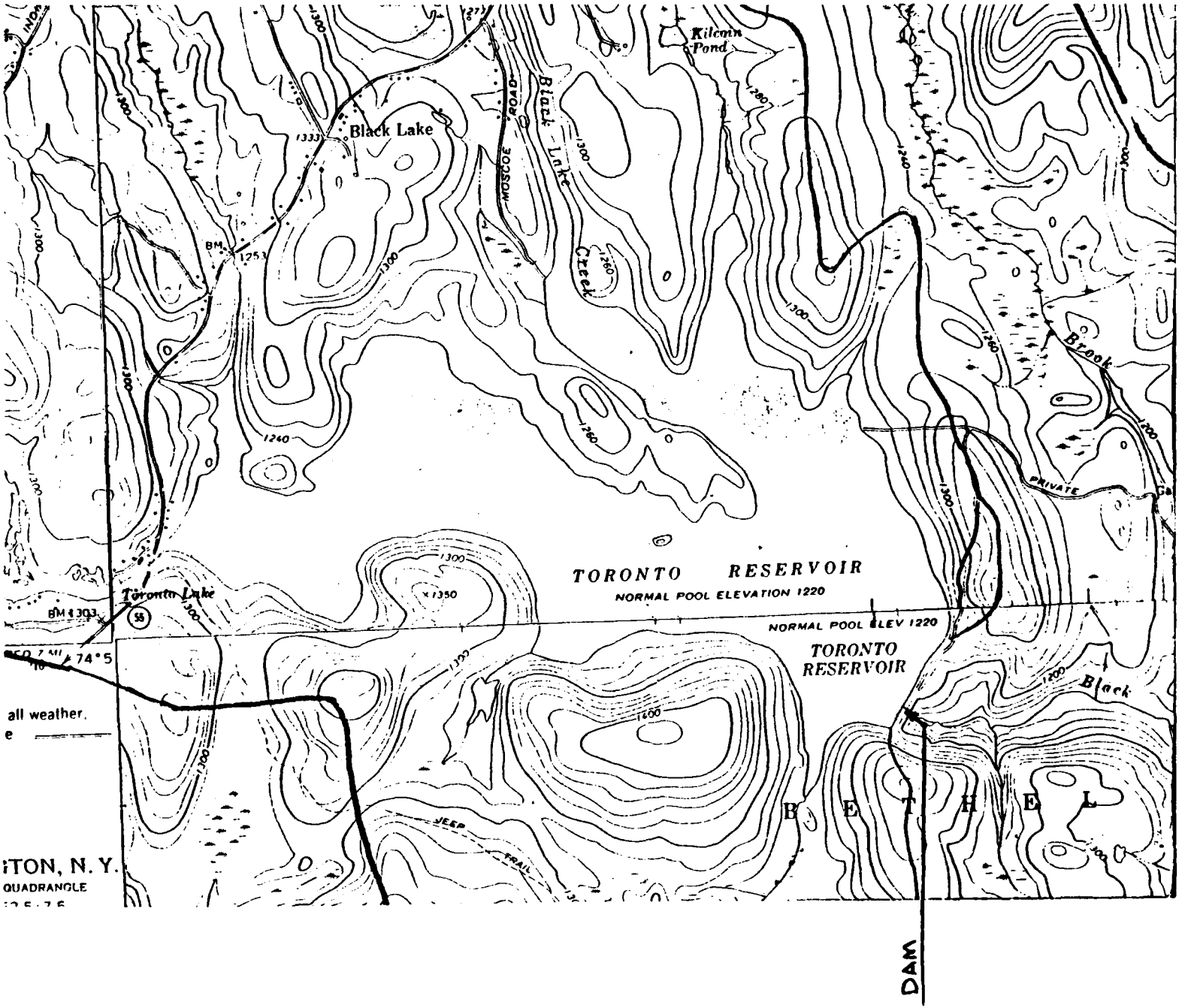
6) University of the State of New York, Geology of New York, Education Leaflet 20, Reprinted 1973.

7) Cornell University Agriculture Experiment Station (compiled by M.G. Cline and R.L. Marshall), General Soil Map of New York State and Soils of New York Landscapes, Information Bulletin 119, 1977.

APPENDIX E

DRAWINGS


SULLIVAN COUNTY
SHOWING
STATE, COUNTY & TOWN
HIGHWAY SYSTEMS
FALLSBURG
BETHEL
THOMPSON
LUMBERLAND
FOREST BURG
HIGHLAND
LAMAKATING
WANAKSINK
MONTICELLO
THOMPSONVILLE
SOUTH FALLSBURG
MOUNTAINDALE
PHILLIPSPORT
SUMMITVILLE
BURLINGHAM
ROSA
KIAMESHA
MONGAUP FALLS DAM
SWINGING BRIDGE DAM
DAM
ULSTER COUNTY
ORANGE COUNTY
To ELLENVILLE
To MIDDLETOWN
To PORT JERVIS
RIVER



TOPOGRAPHIC MAP

Robert F. Flacke

December 10, 1979

Mr. Frank Kiernan
Director of Electrical Production
75 W. Rt. #59
Spring Valley, New York 10977

Re: Toronto Reservoir Dam
#148D-199
Delaware River Basin

Dear Frank:

As a result of our field inspection of the subject dam on November 15 and 16, 1979, certain problem areas were discovered which require your immediate attention. These areas are as follows:

1. Seppage was observed emminating from the downstream toe of the dam on both sides of the reservoir drain outlet. The seepage was evident at three concentrated locations on the right side of the reservoir drain and several points along the abutment contacts and the banks of the downstream channel. The seepage flow was clear. However, in two locations there appears to be rusty colored algae and particles spread out in a delta fan immediately below the seepage points. Seepage rate is estimated to be 10 gallons per minute from the three concentrated areas and approximately 20 gpm from the remaining areas. The water level in the reservoir at the time of the inspection was 40 feet below normal pool.

2. Inspection of the reservoir drain conduit revealed extensive concrete deterioration at the construction joints and at the downstream end of the conduit. Calcification and seepage was evident at all joints throughout the conduit. At two locations seepage at a rate of approximately 1-2 gpm was observed flowing through the joints.

In light of these conditions, you are requested to perform the following repair and monitoring programs:

A. Install weirs or other flow measuring devices at the seepage points described and monitor the discharge at weekly intervals. During filling of the reservoir if appreciable increases in reservoir levels are encountered monitor the seepage flow more frequently. Record flow rates in gallons per minute for all seepage points and indicate the corresponding reservoir and tailwater elevations.

B. Repair the deteriorated concrete of the reservoir drain conduit and seal the leaking construction joints. In addition repair the center pier in the throat of the conduit outlet. These repairs should be accomplished before the reservoir level is raised so that the work may be accomplished under a low hydrostatic head.

If you have any further questions or comments, please contact me at (518) 457-5557.

Thank you for your cooperation.

Sincerely,

Robert P. McCarty
Senior Civil Engineer

RPM/ps

cc: Mr. Levers
Mr. Hebson
Mr. Danskin

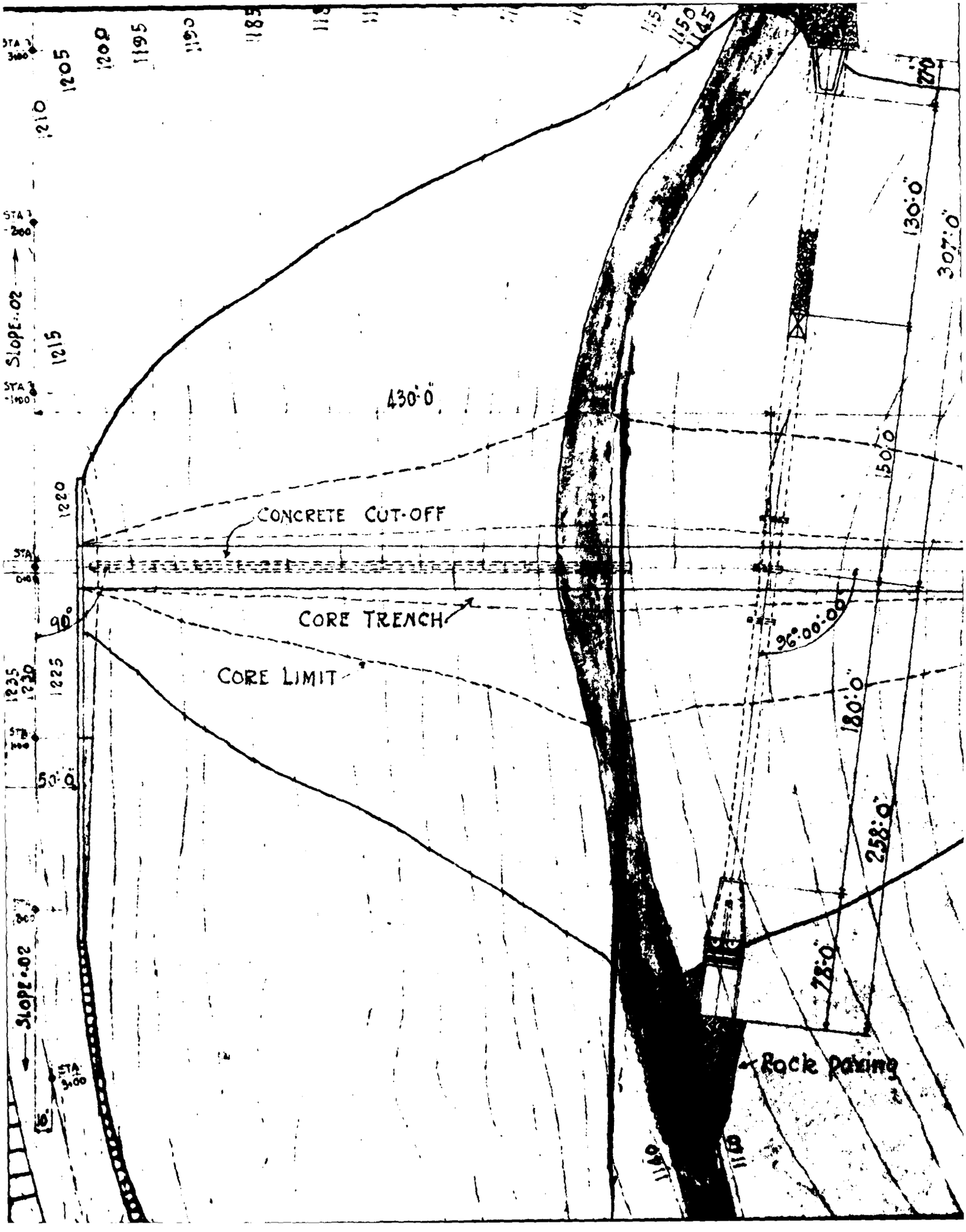
TORONTO RESERVOIR DAM

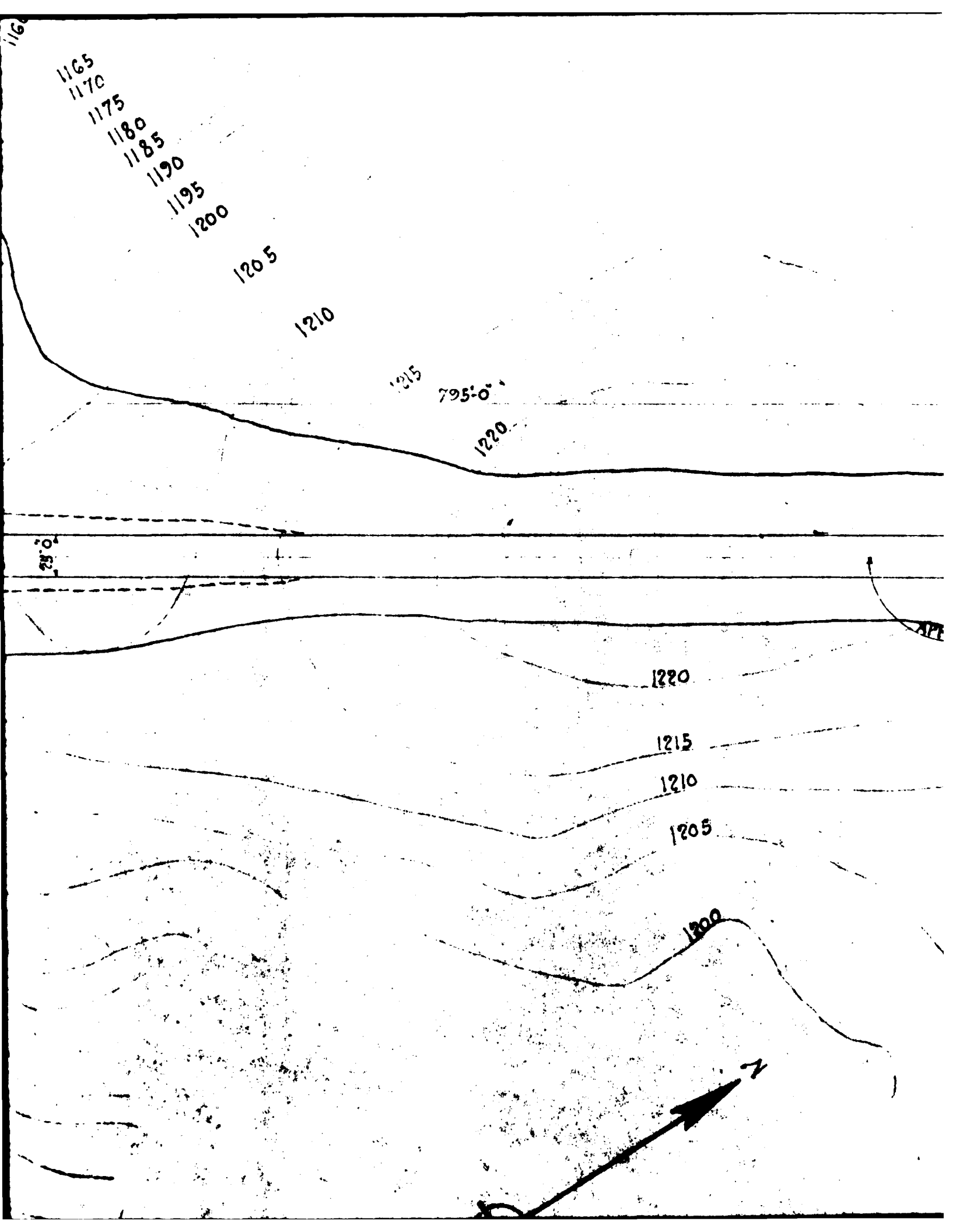
List of Drawings

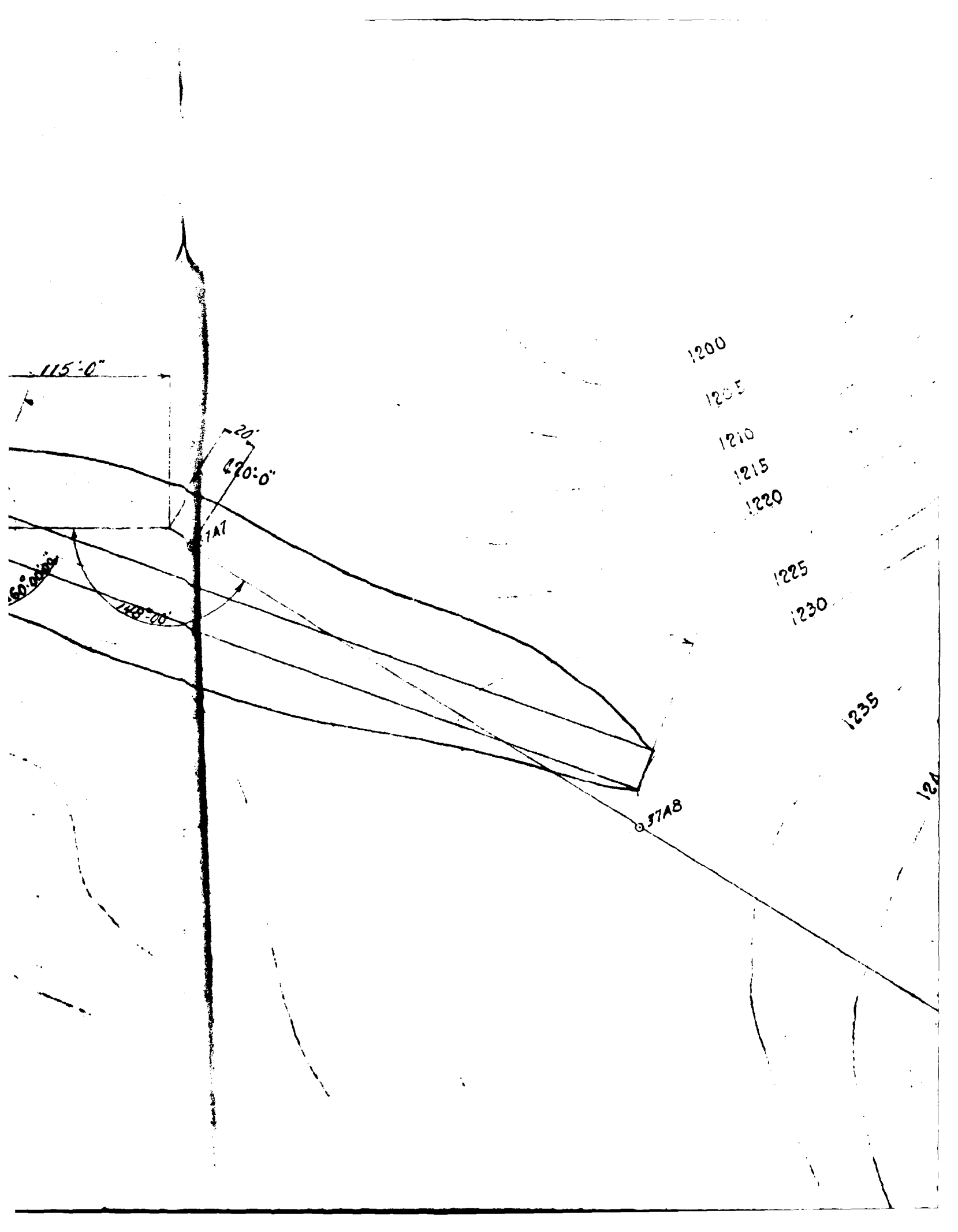
DAM - General Plan	kk-3-1

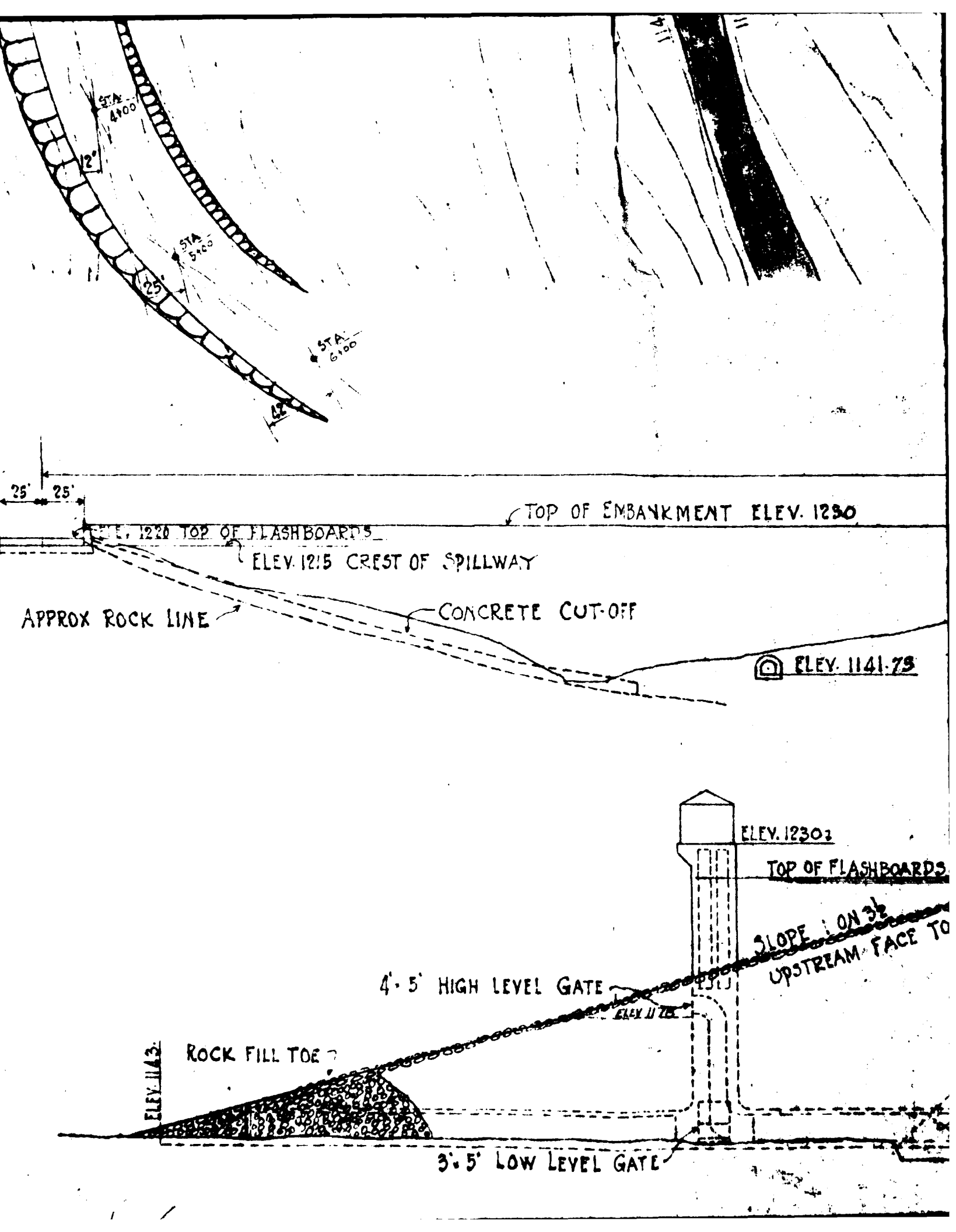
Note: The following plans are for illustrative purposes. The proposed pipeline and appurtenances from Toronto to Swinging Bridge Reservoir was not constructed.

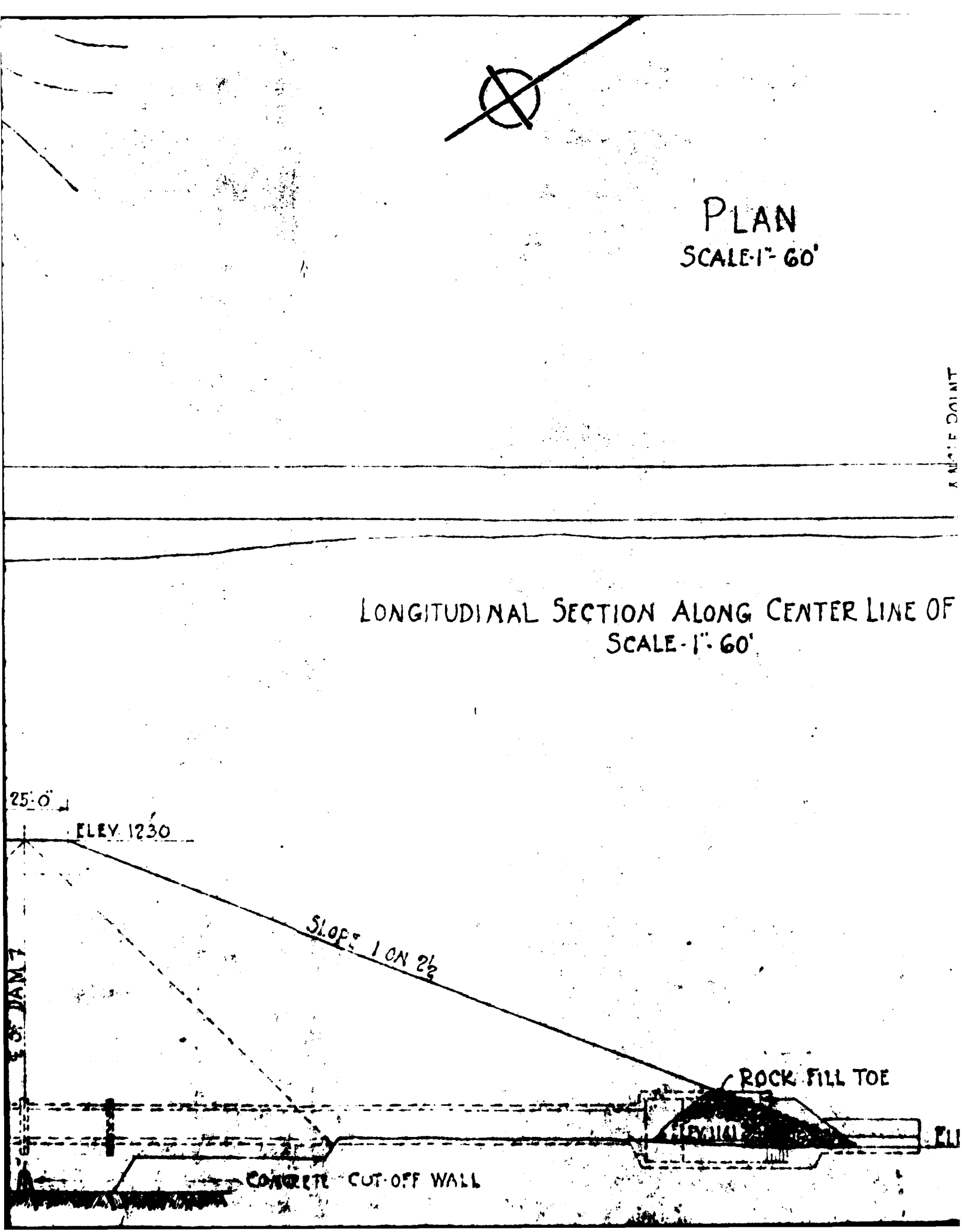
Toronto Pipeline Development	
General Plan	kk-3-360
Penstock Connection to Conduit	kk-3-371


CONCRETE CUT-OFF
CORE TRENCH
CORE LIMIT
Rock paving
SLOPE 1:02
SLOPE 1:02
430'0"
307'0"
130'0"
150'0"
180'0"
258'0"
78'0"
96°00'00"
90°
50'0"


1165
1170
1175
1180
1185
1190
1195
1200
1205
1210
1215
795'-0"
1220
28'-0"
1220
1215
1210
1205
1200
N


115'-0"
20'
220'-0"
1A7
148'-00"
1200
1205
1210
1215
1220
1225
1230
1235
57A8


STA 4+00
12'
STA 5+00
25'
STA 6+00
42'
25'
25'
TOP OF EMBANKMENT ELEV. 1230
ELEV. 1220 TOP OF FLASHBOARDS
ELEV. 1215 CREST OF SPILLWAY
APPROX ROCK LINE
CONCRETE CUT-OFF
ELEV. 1141.75
ELEV. 1230
TOP OF FLASHBOARDS
SLOPE 1 ON 3½
UPSTREAM FACE TO
4'-5' HIGH LEVEL GATE
ELEV 1175
ROCK FILL TOE
ELEV. 1143
3'-5' LOW LEVEL GATE


PLAN
SCALE-1"-60'
LONGITUDINAL SECTION ALONG CENTER LINE OF
SCALE-1"-60'
25'-0"
ELEV 1230
SLOPE 1 ON 2½
ROCK FILL TOE
CONCRETE CUT-OFF WALL

420·0

APPROVED:

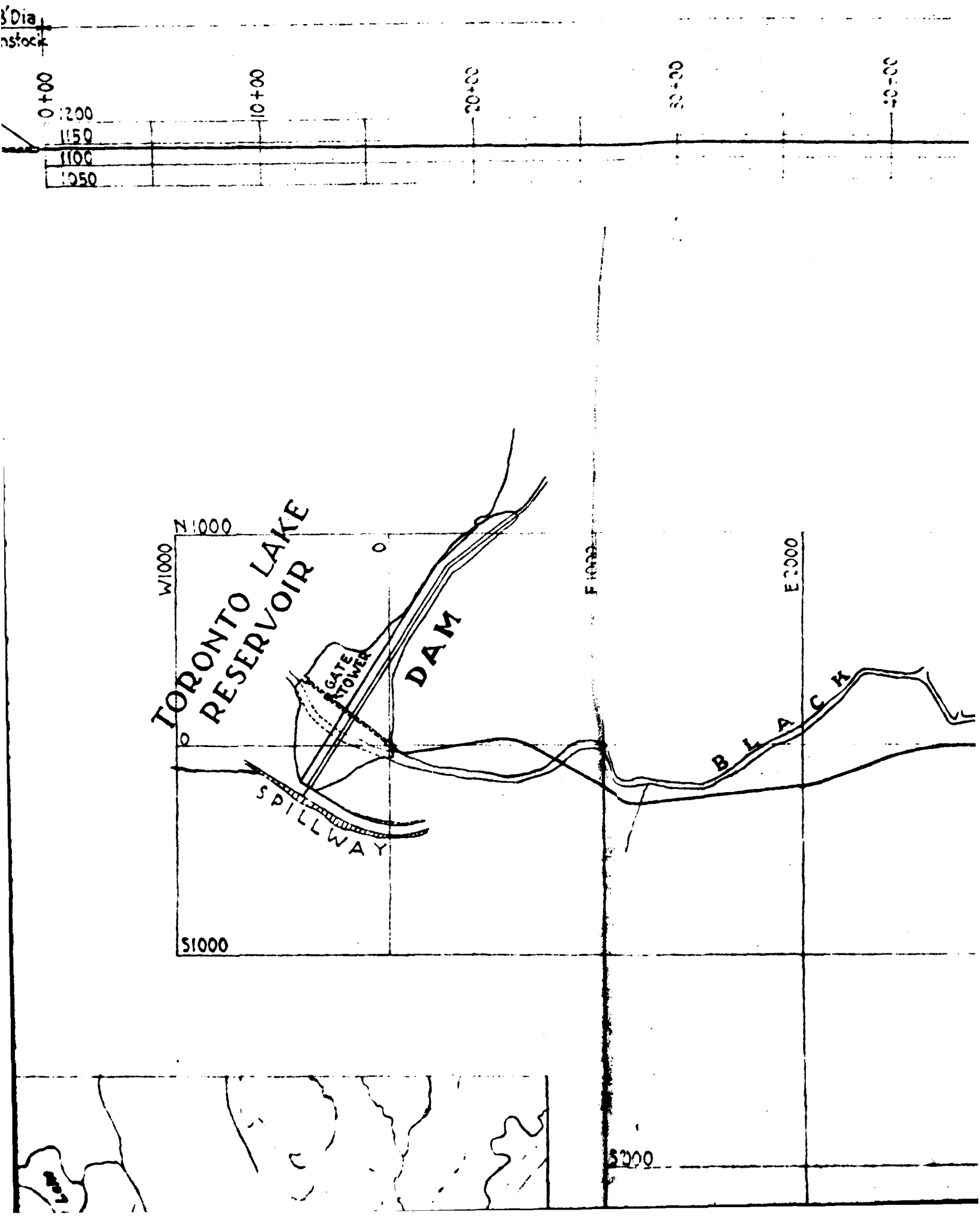
CHAS. T. MAIN, CONSULTING ENG
200 DEVONSHIRE ST
BOSTON, MASS
BY Chas. T. Main

CATSKILL POWER CORP. MIDDLETOWN N.Y.

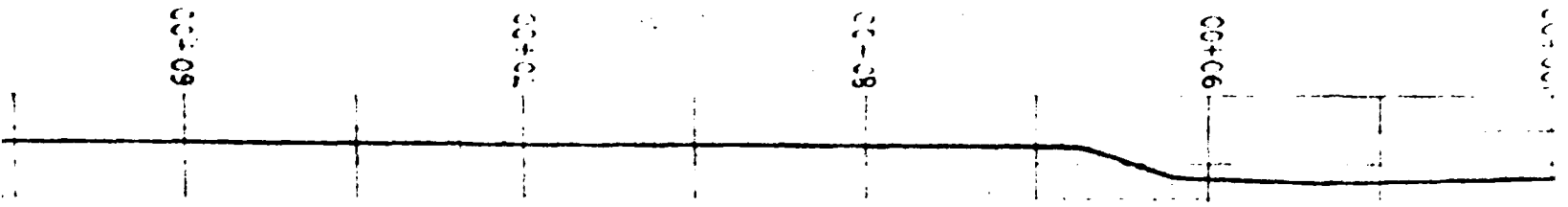
REVISIONS		

TORONTO LAKE RESERVOIR
DAM
GENERAL PLAN

PREPARED BY CHARLES H. [illegible] & CO.
ENGINEERS [illegible]

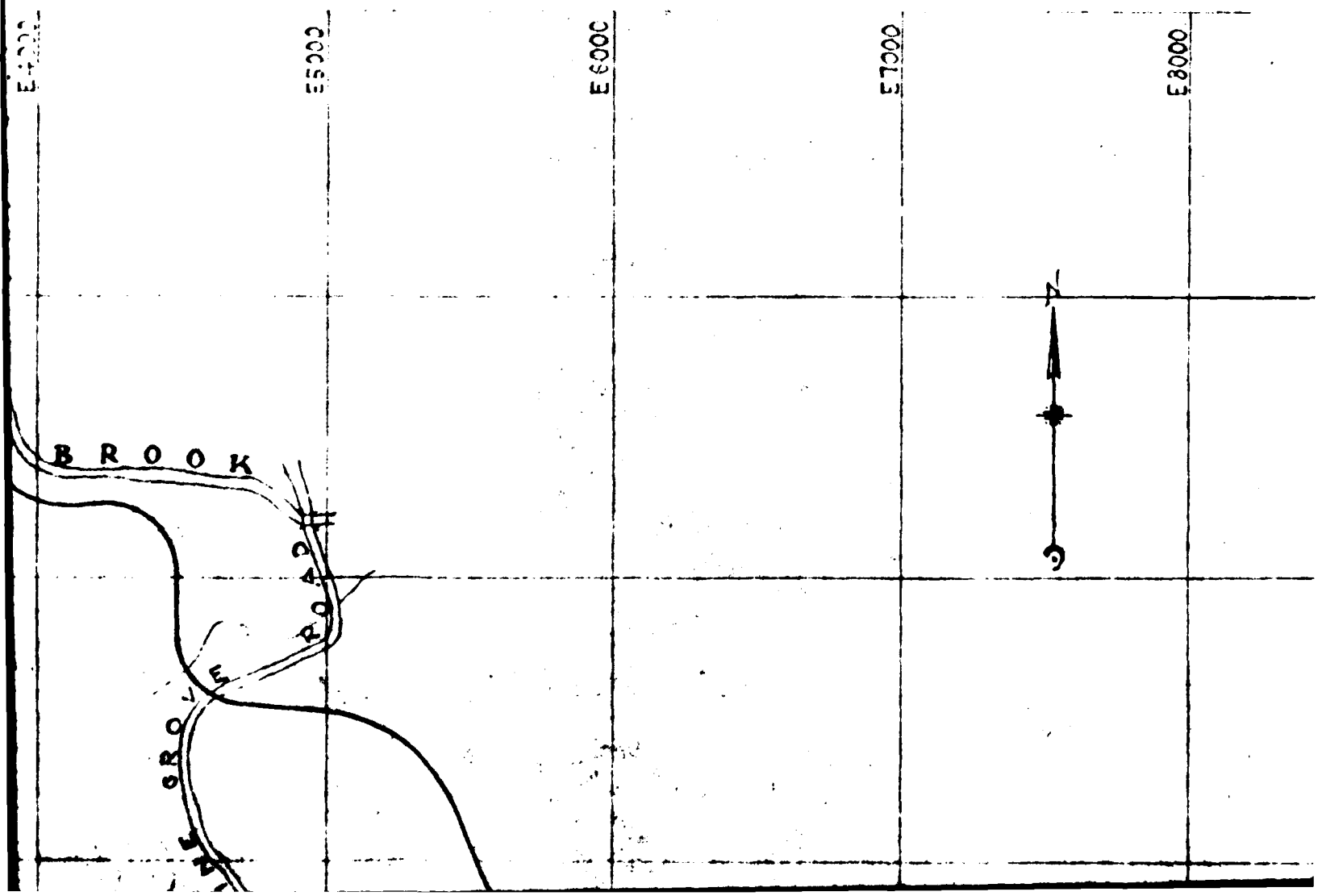

0+00
10+00
20+00
30+00
40+00
1200
1150
1100
1050
TORONTO LAKE RESERVOIR
DAM
GATE TOWER
SPILLWAY
BLACK
N1000
W1000
E2000
S1000
S2000

14500'-4'-8" Dia Wood Stave Pipe

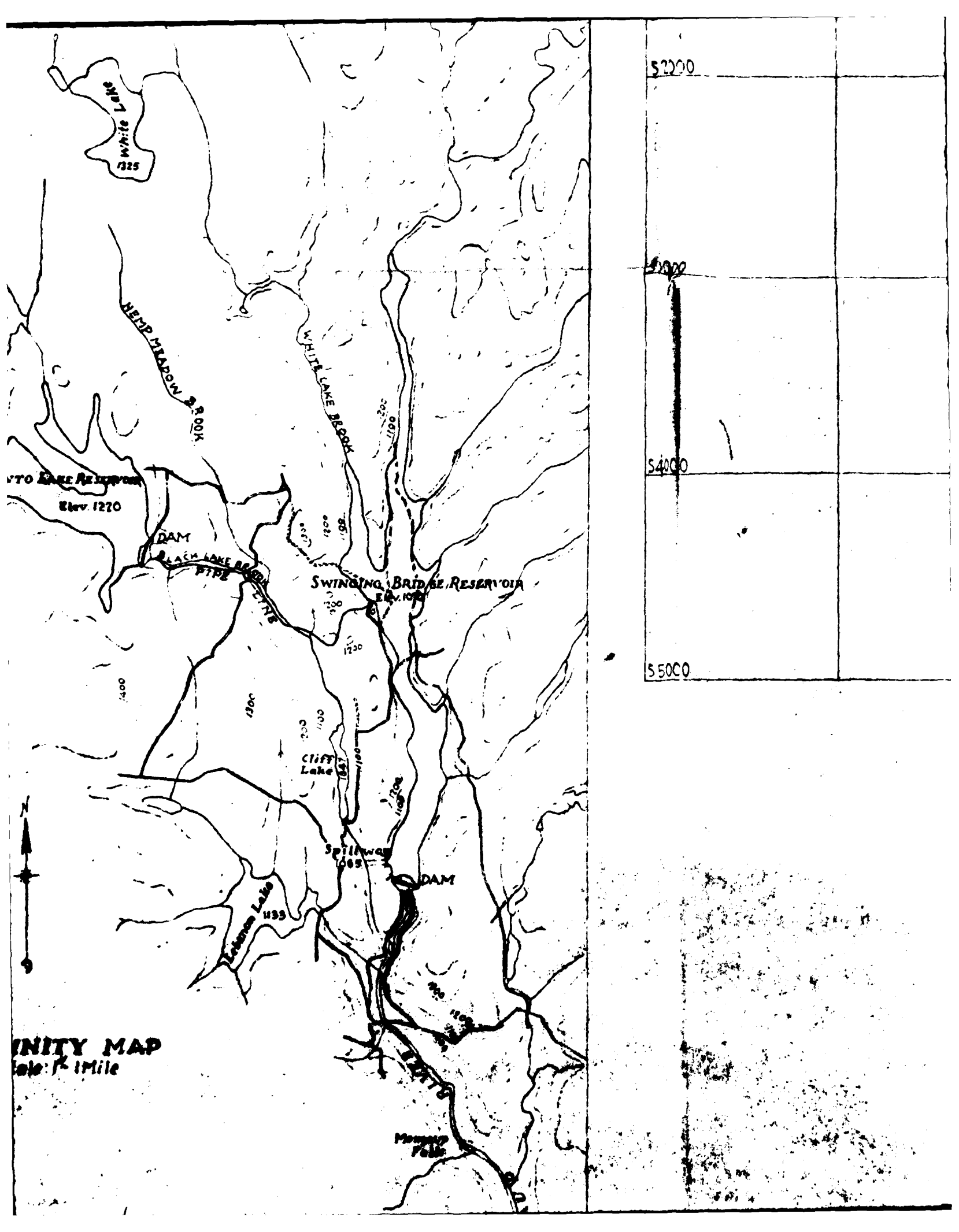


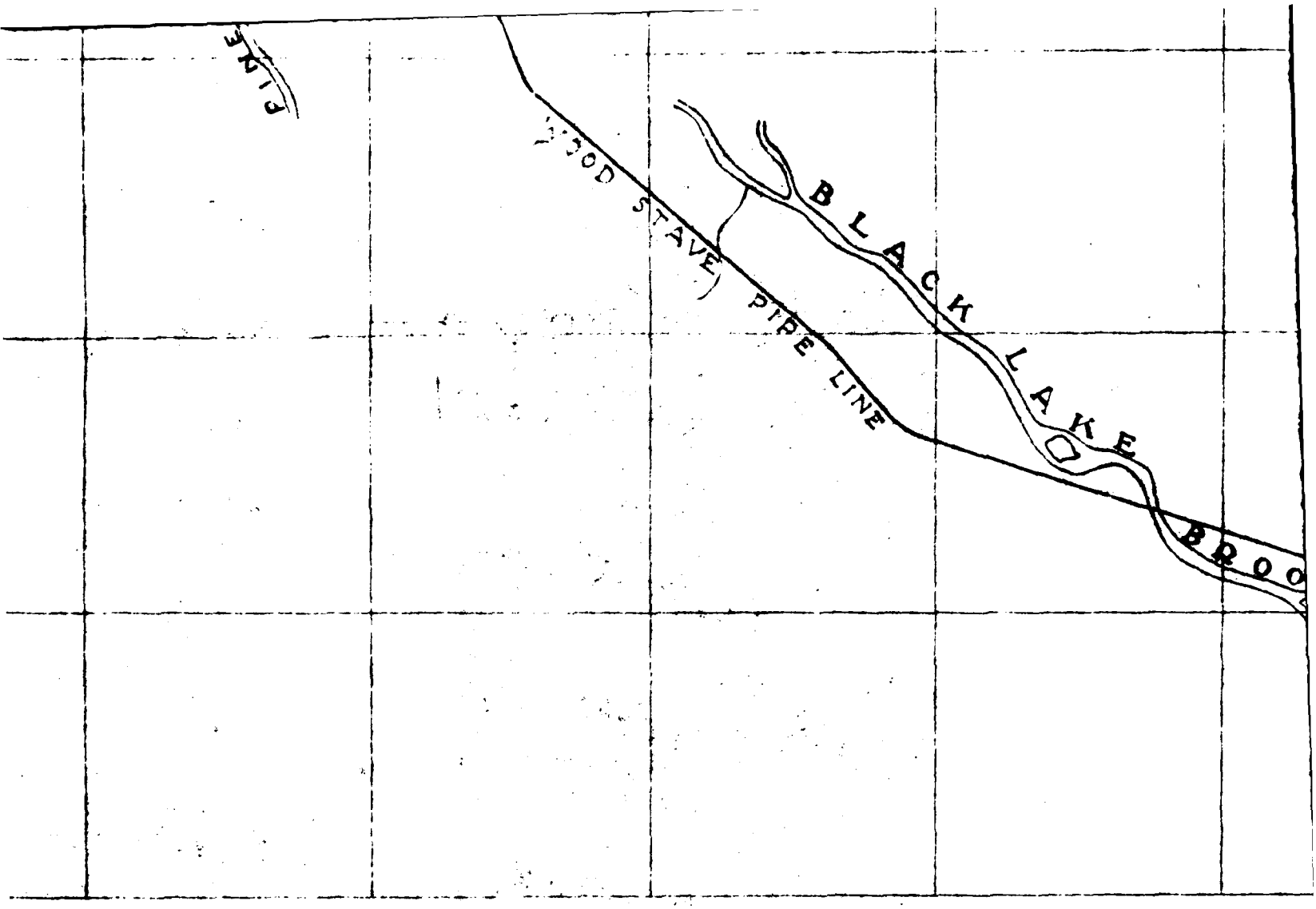
PROFILE ON CENTER LINE OF PIPE

Scales: Horiz. - 1" = 500'
Vert. - 1" = 250'



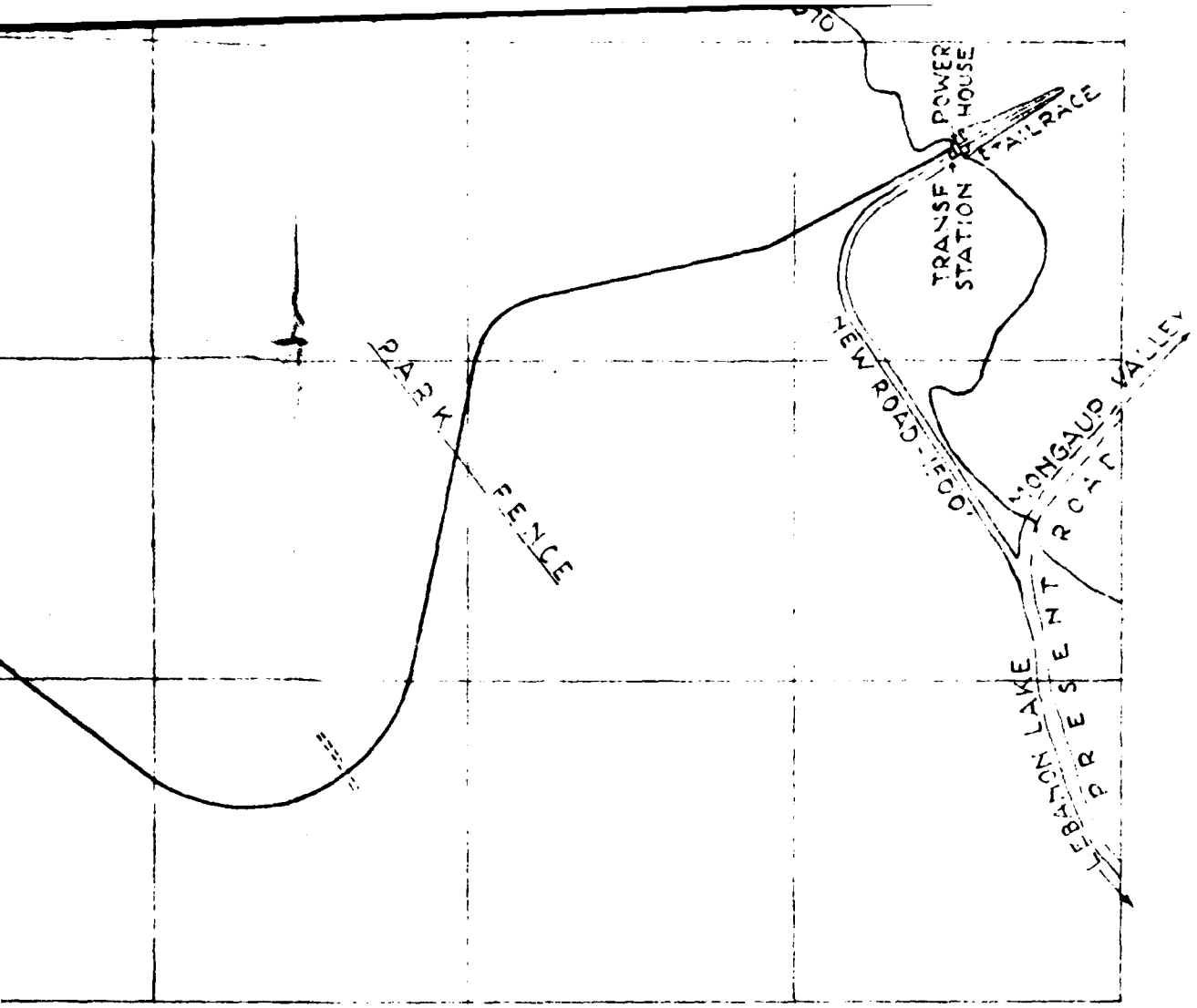
40+00
45+00
Power House
E 9000
E 10,000
E 11,000
E 12,000
SWINGING BRIDGE
RESERVOIR
WHITE LAKE
BROOK
RESERVOIR H.W. EL. 1070
POWER HOUSE
TAILRACE


White Lake
1325
NEMP MEADOW BROOK
WHITE LAKE BROOK
1100
1200
Elev. 1220
DAM
BEACH LAKE RESERVOIR
PIPE
SWINGING BRIDGE RESERVOIR
1230
1300
1000
1100
Cliff Lake
1291
1200
Spillway
1069
DAM
Lemon Lake
1139
1100
Mohawk Falls
52200
54000
55000
N
INITY MAP
ale: 1" = 1Mile



PLAN

Scale: 1"=500'

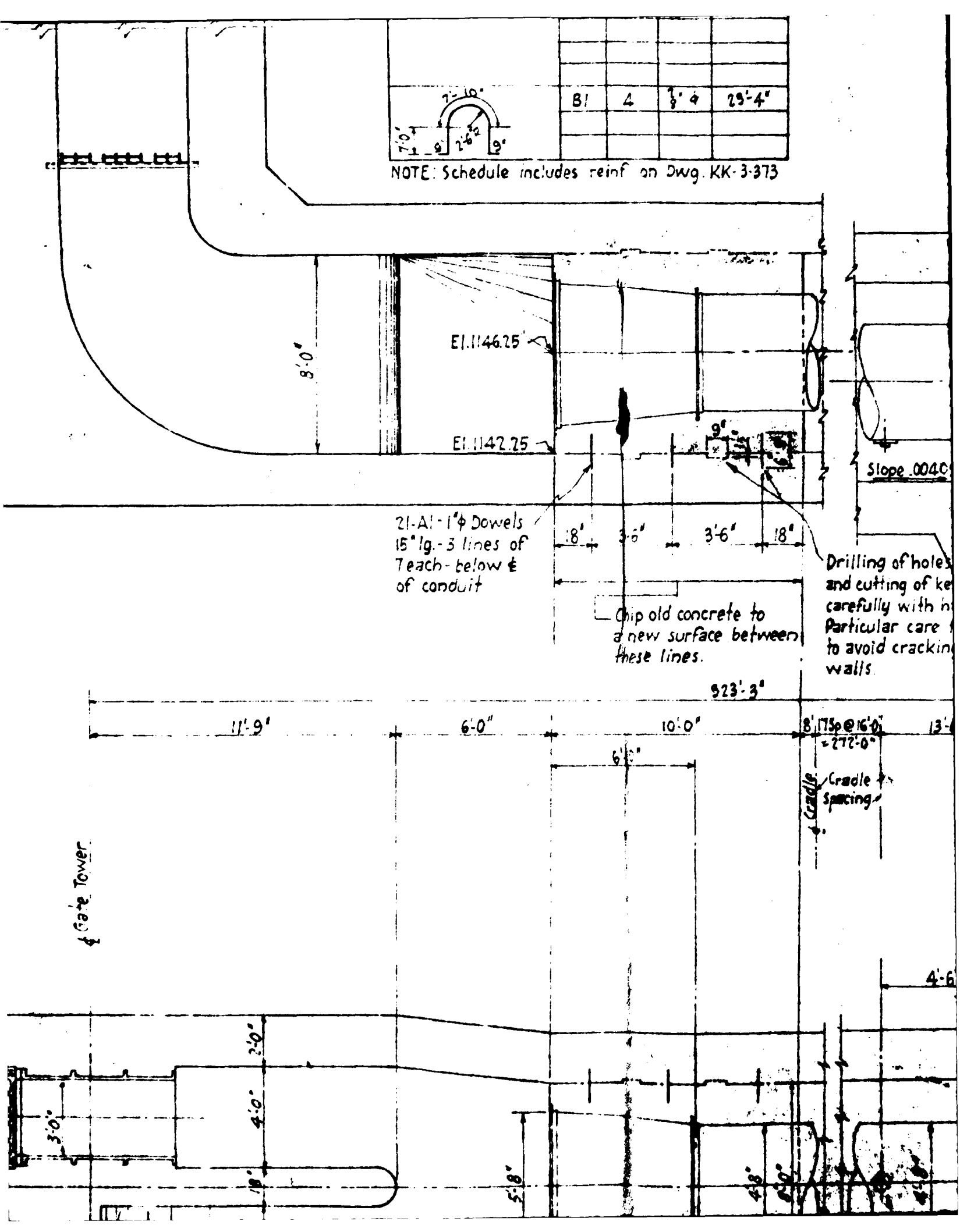


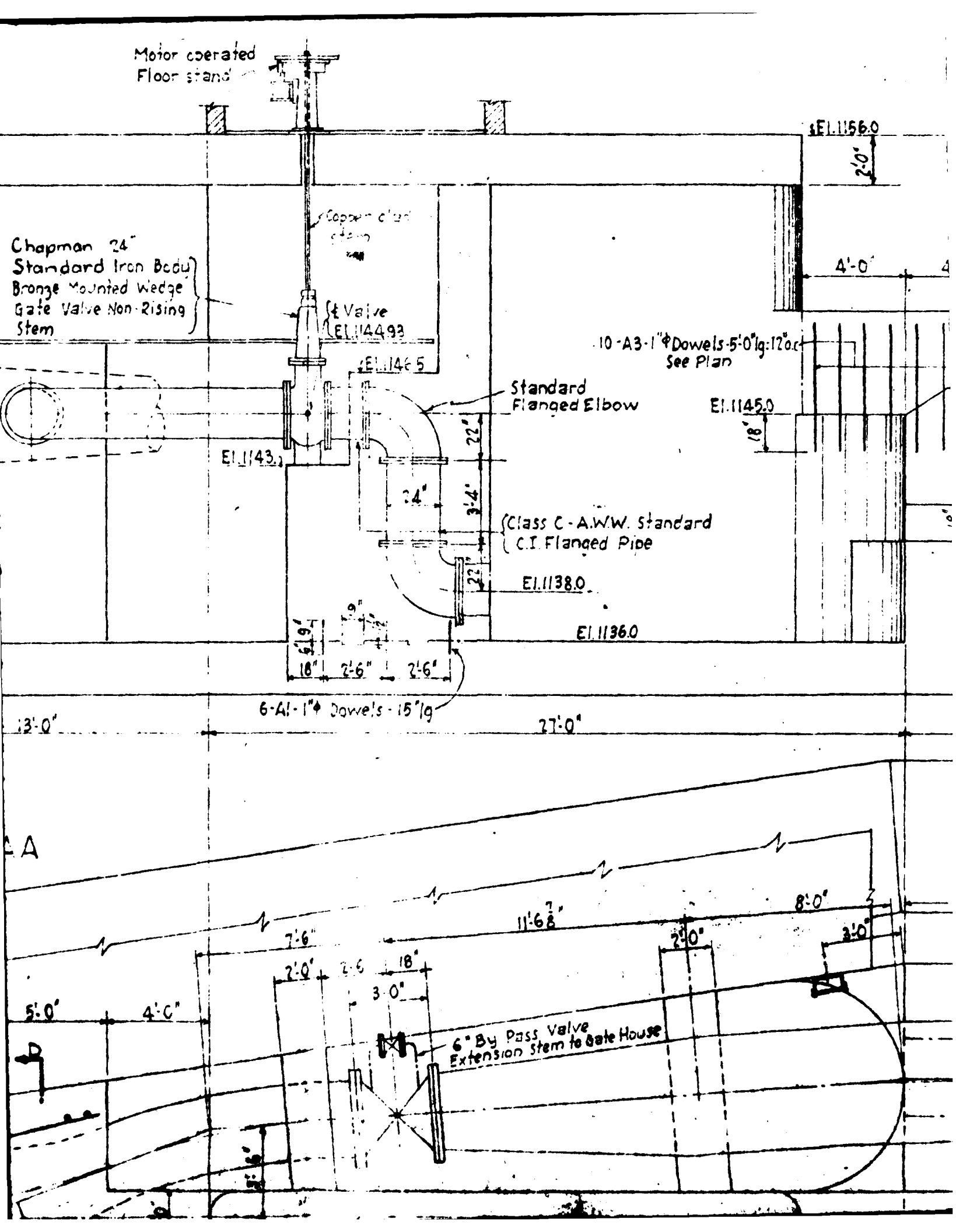
APPROVED:
CHAS. T. MAIN, INC. CONSULTING ENG'RS.
201 DEVONSHIRE STREET
BOSTON, MASS.
BY W. F. Uhl

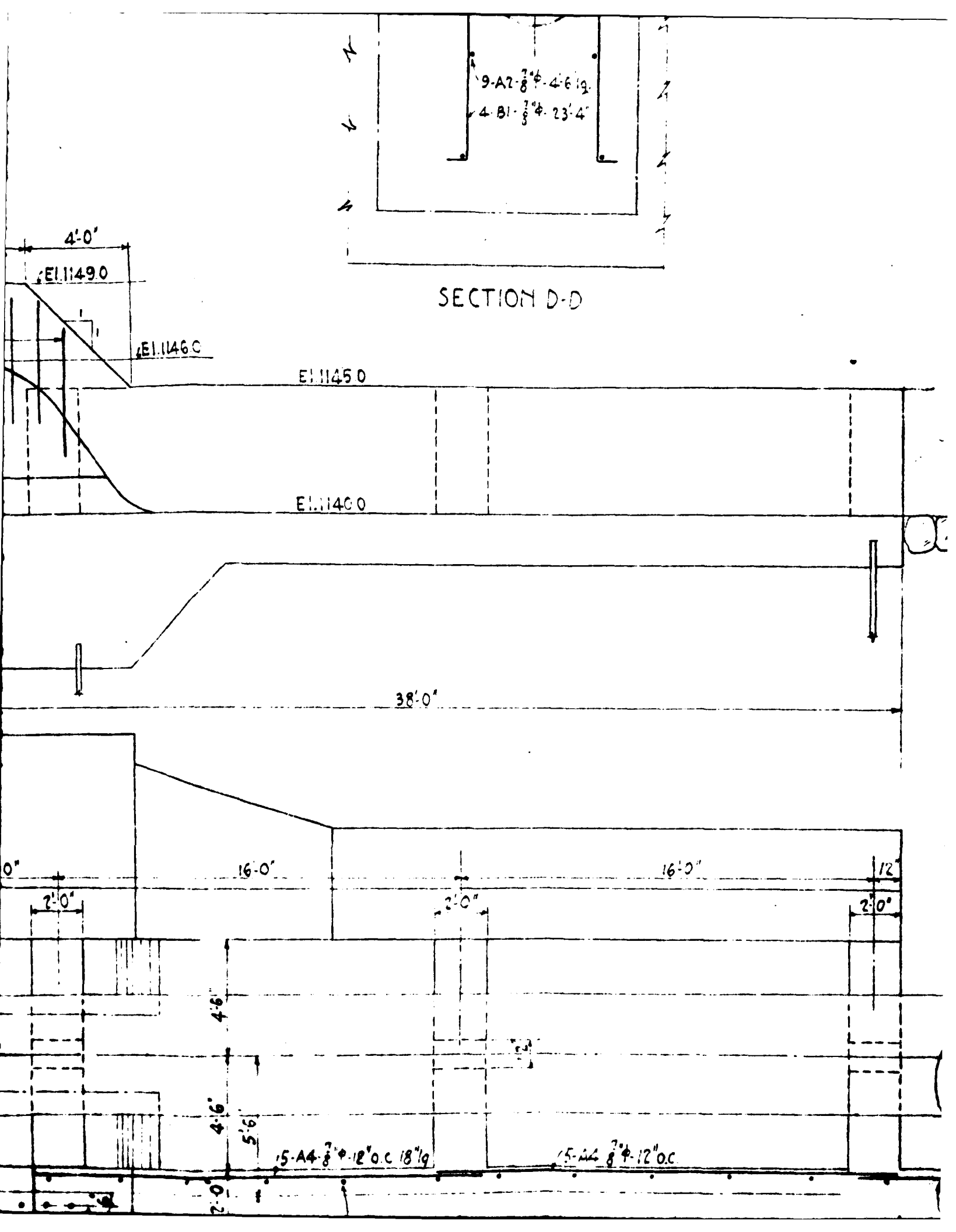
ROCKLAND LIGHT & POWER CO. NY

REVISIONS		TORONTO PIPE LINE DEVELOPMENT GENERAL PLAN	Drawn	Traced
			Examined:	
		PREPARED BY CHARLES H. TENNEY & CO. ENGINEERS BOSTON, MASS.	Approved: W. F. U.	

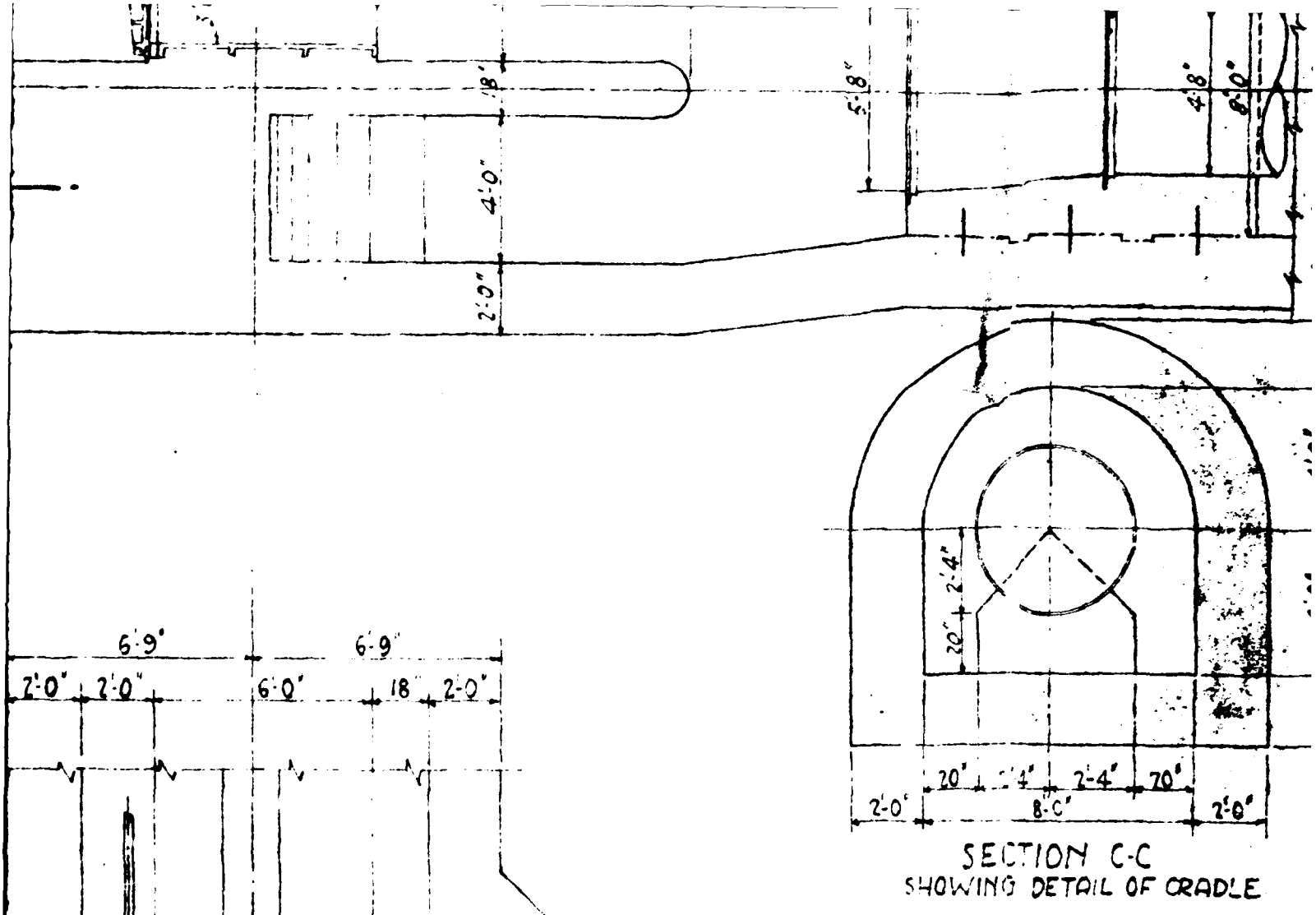
3


B1 4 3/8" ϕ 29'-4"
7'-10"
7'-0"
2'-6"
NOTE: Schedule includes reinf on Dwg. KK-3-373
8'-0"
El. 1146.25
El. 1142.25
9"
Slope .004
21-A1-1"ϕ Dowels 15" lg. - 3 lines of 7 each - below ℄ of conduit
18"
3'-6"
3'-6"
18"
Drilling of holes and cutting of ke carefully with h Particular care to avoid crackin walls
Chip old concrete to a new surface between these lines.
923'-3"
11'-9"
6'-0"
10'-0"
8 @ 17Sp @ 16'-0" = 272'-0"
13'-
6'-0"
Cradle
Cradle Spacing
℄ Gate Tower
4'-6
2'-0"
4'-0"
3'-0"
19"
5'-8"
4'-8"
5'-0"


Motor operated
Floor stand
℄ El. 1156.0
2'-0"
Copper clad
stem
Chapman 24"
Standard Iron Body
Bronze Mounted Wedge
Gate Valve Non-Rising
Stem
℄ Valve
El. 1144.93
4'-0"
10-A3-1"ϕ Dowels-5'-0"lg:12"o.c
See Plan
El. 1146.5
Standard
Flanged Elbow
El. 1145.0
18"
El. 1143.2
22"
24"
3'-4"
Class C-A.W.W. Standard
C.I. Flanged Pipe
22"
El. 1138.0
El. 1136.0
9"
6'-9"
18"
2'-6"
2'-6"
6-A1-1"ϕ Dowels-15"lg
13'-0"
27'-0"
A
11'-6 7/8"
8'-0"
7'-6"
2'-0"
2'-6"
18"
3'-0"
2'-0"
3'-0"
5'-0"
4'-0"
6" By Pass Valve
Extension Stem to Gate House

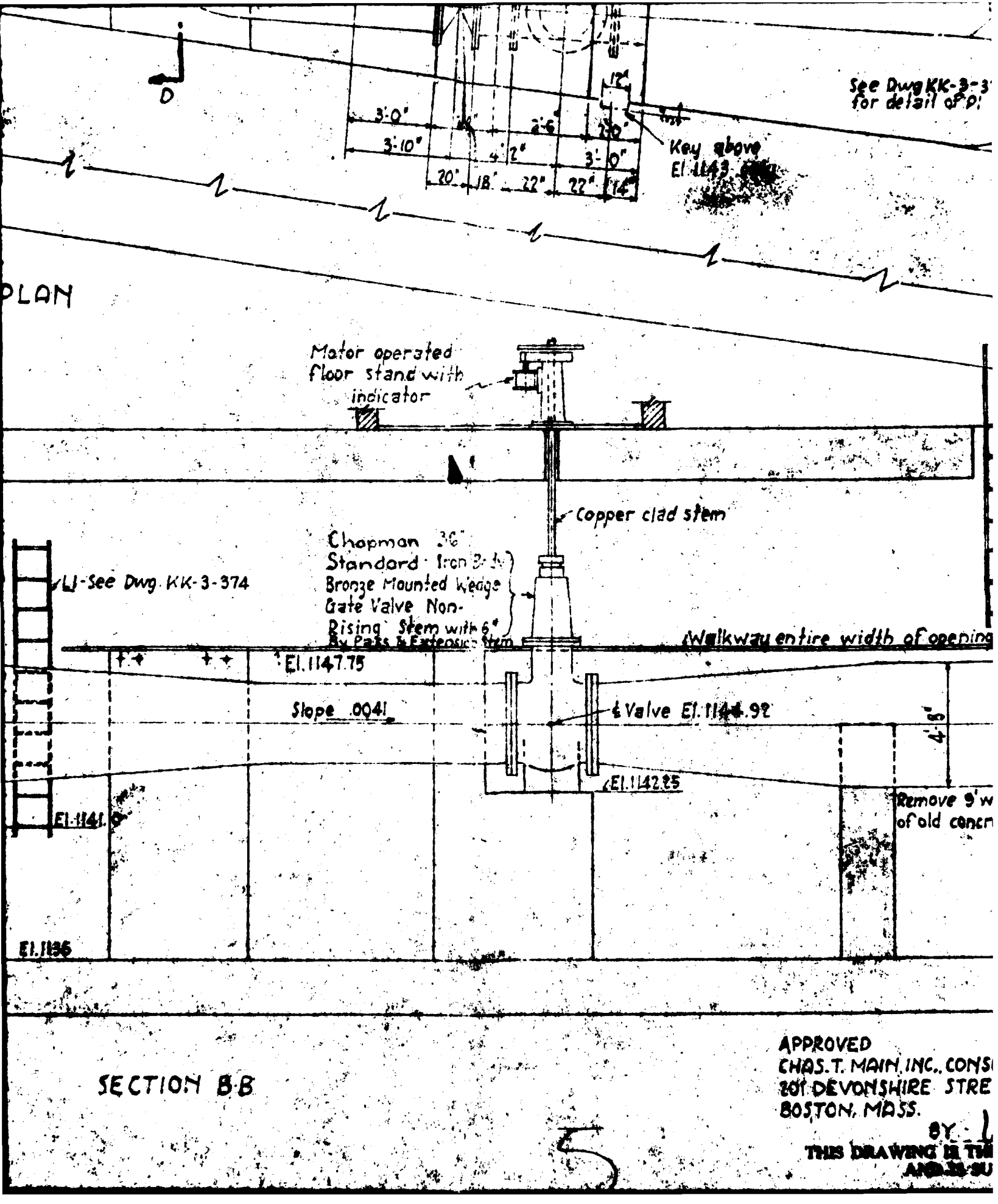

9-A2-⅞"ϕ-4'-6" lg.
4-B1-⅞"ϕ-23'-4"
4'-0"
EL.1149.0
EL.1146.0
EL.1145.0
EL.1140.0
38'-0"
16'-0"
16'-0"
2'-0"
2'-0"
2'-0"
4'-6"
4'-6"
5'-6"
2'-0"
15-A4-⅞"ϕ-12" O.C 18" lg
15-A4-⅞"ϕ-12" O.C

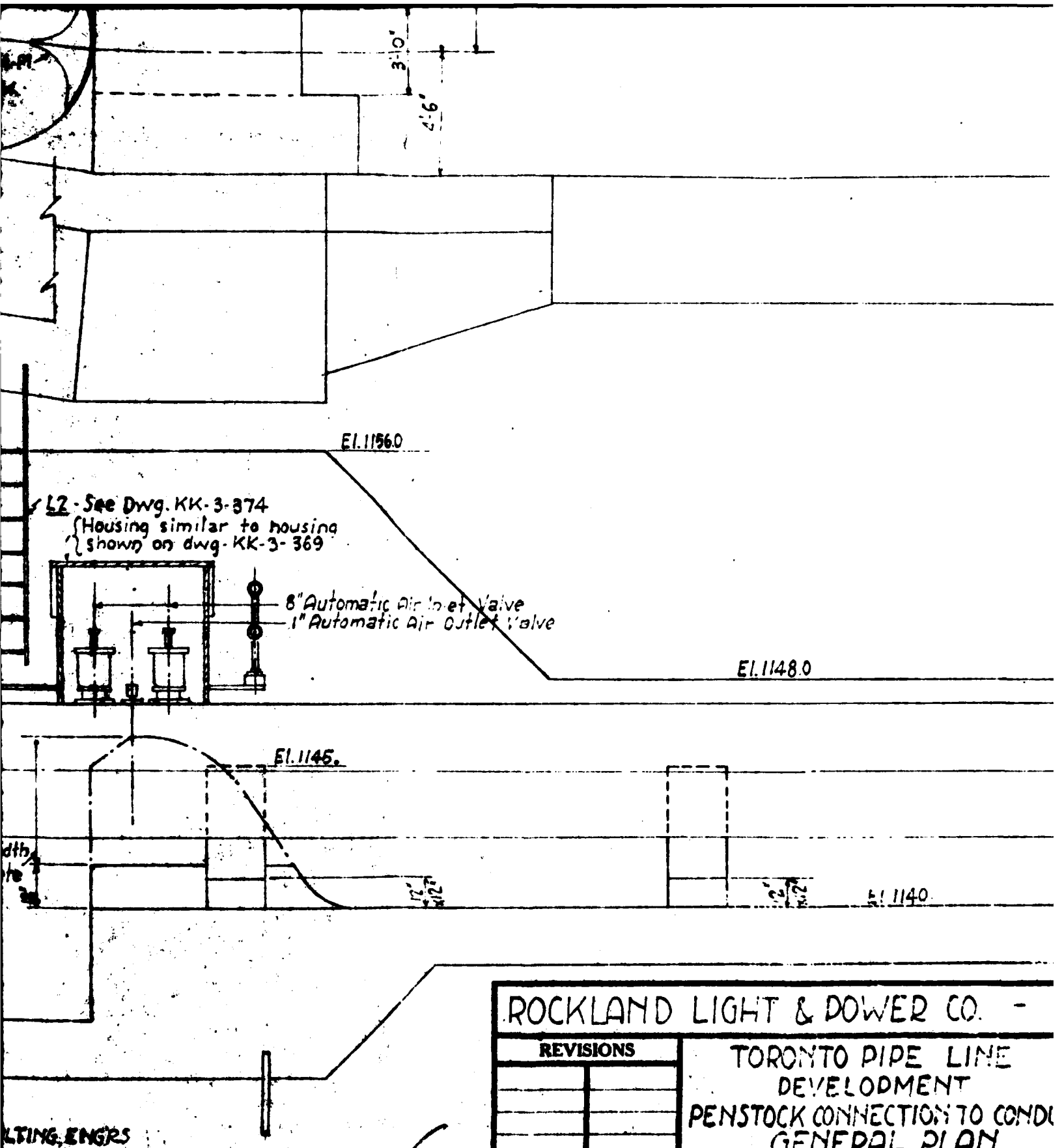
SECTION D-D



SECTION C-C
SHOWING DETAIL OF CRADLE

AD-A091 207 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. TORONTO RESERVOIR DAM. (INVENTORY --ETC(U)
AUG 80 G KOCH DACW51-79-C-0001
UNCLASSIFIED NL


D
3'-0"
3'-10"
20"
18"
22"
22"
14"
4'2"
2'6"
3'-0"
12"
Key above El. 1143
See Dwg KK-3-3
for detail of D
PLAN
Motor operated floor stand with indicator
Copper clad stem
Chapman 36" Standard Iron Bronze Mounted Wedge Gate Valve Non-Rising Stem with 6" By Pass & Extension Stem
LJ-See Dwg. KK-3-374
Walkway entire width of opening
El. 1147.75
Slope .0041
& Valve El. 1144.92
4'6"
El. 1142.25
El. 1141.0
Remove 9' w
of old concr
El. 1136
SECTION B-B
APPROVED
CHAS. T. MAIN, INC., CONS
201 DEVONSHIRE STRE
BOSTON, MASS.
BY
THIS DRAWING IS TH
AND IS SU



ROCKLAND LIGHT & POWER CO.

REVISIONS	

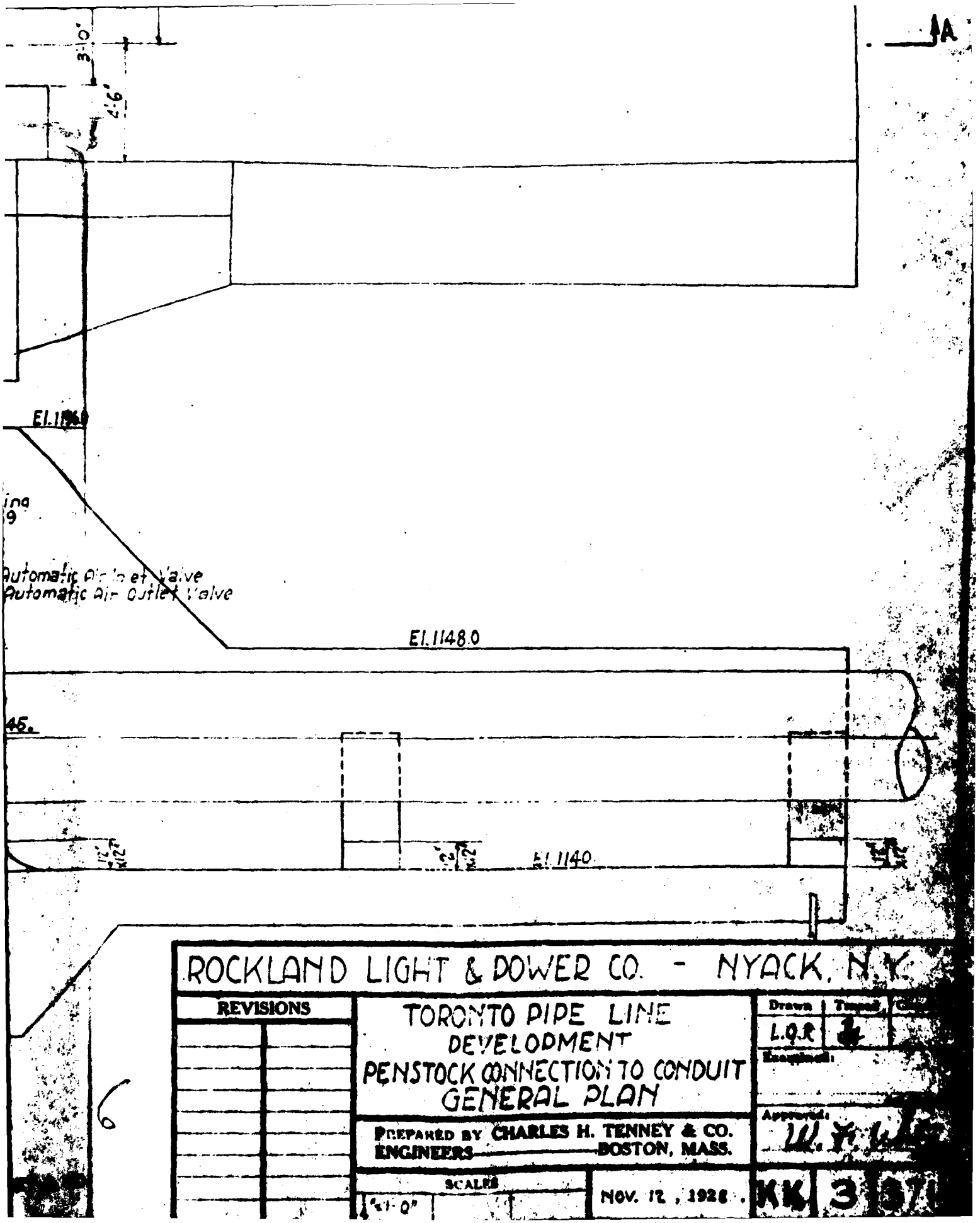
TORONTO PIPE LINE
DEVELOPMENT
PENSTOCK CONNECTION TO CONDU
GENERAL PLAN

PREPARED BY CHARLES H. TENNEY & C
ENGINEERS BOSTON, MA

SCALES	
1/4"-1'-0"	NOV. 12, 192

LTING, ENGRS
T.

PROPERTY OF CHARLES H. TENNEY & CO.



ROCKLAND LIGHT & POWER CO. - NYACK, N.Y.

REVISIONS		TORONTO PIPE LINE DEVELOPMENT PENSTOCK CONNECTION TO CONDUIT GENERAL PLAN	Drawn L.Q.R.	Traced	Checked
		PREPARED BY CHARLES H. TENNEY & CO. ENGINEERS BOSTON, MASS.	Approved: W. F. Wells		
		SCALES 1"=1'-0" NOV. 12, 1928.	KK 3 371		